U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-244 841

APPENDICES TO A HANDBOOK FOR INITIATING OR IMPROVING COMMERCIAL REFUSE COLLECTION

City of Scottsdale

Prepared for
Environmental Protection Agency

June 1974

BIBLIOGRAPHIC DATA SHEET

1. Report No. EPA/530/SW-85d.1

2.

PB 244 841

4. Title and Subtitle
Appendices to a handbook for initiating or improving commercial refuse collection

5. Report Date
June, 1974

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address

City of Scottsdale, Arizona
3939 Civic Center Plaza
Scottsdale, Arizona 85251

10. Project/Task/Work Unit No.

11. ~~Contract~~/Grant No.
S-801741

12. Sponsoring Organization Name and Address

U.S. Environmental Protection Agency
Office of Solid Waste Management Programs
Washington, D.C. 20460

13. Type of Report & Period Covered
final

14.

15. Supplementary Notes
Supplements the final report published by the Environmental Protection Agency in the solid waste management series(SW-85d) under the same title. Single copies of that report are available from Solid Waste Management Information Materials Distribution, U.S. Environmental Protection Agency, Cincinnati, Ohio 45268.

16. Abstracts

This report consists of the"Appendices"to "A handbook for initiating or improving commercial refuse collection" which is available from the Office of Solid Waste Management Programs, EPA. The entire study examines the major components of a commercial refuse collection operation for the purpose of improving the efficiency and effectiveness of existing businesses or of aiding those contemplating entry into the field. The information contained in this study is applicable to both the public and the private sectors. The "Handbook" itself contains information that is more general in nature as compared with the"Appendices," which focus directly on a limited number of topics. Both publications should be of value to anyone interested in commercial collection.

17. Key Words and Document Analysis. 17a. Descriptors

Refuse disposal; waste disposal

Contents are as follows: [illegible]

17b. Identifiers/Open-Ended Terms

Commercial collection; Sample contracts; Management information and cost accounting systems; user charges

Reproduced by
NATIONAL TECHNICAL INFORMATION SERVICE
US Department of Commerce
Springfield, VA. 22151

PRICES SUBJECT TO CHANGE

17c. COSATI Field/Group

18. Availability Statement

19. Security Class (This Report) UNCLASSIFIED

20. Security Class (This Page UNCLASSIFIED

21. No. of Pages 186

22. Price $ 7.00

252 135

APPENDICES TO A HANDBOOK FOR INITIATING OR IMPROVING COMMERCIAL REFUSE COLLECTION

These appendices (SW-85d.1) supplement the Handbook prepared
under solid waste management grant no. S-801741
by the CITY OF SCOTTSDALE, ARIZONA
and are reproduced as received from the grantee.
The Handbook (SW-85d) was published in 1975
by the U.S. Environmental Protection Agency.

U.S. ENVIRONMENTAL PROTECTION AGENCY

1975

This report as submitted by the grantee or contractor has not been technically reviewed by the U.S. Environmental Protection Agency (EPA). Publication does not signify that the contents necessarily reflect the views and policies of EPA, nor does mention of commercial products constitute endorsement or recommendation for use by the U.S. Government.

An environmental protection publication (SW-85d.1) in the **solid waste** management series.

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APPENDIX I

EQUIPMENT LEASE-PURCHASE DECISIONS

APPENDIX I

EQUIPMENT LEASE-PURCHASE DECISIONS

Special circumstances at the time of equipment acquisition will be determining factors in whether to lease or purchase. In most cases, the decision is based upon (1) the amount of capital available, and (2) assuming sufficient funds are available to consider either method, that which yields the lowest net cash cost based on conditions imposed at the time of the decision.

Financial status of the collector (firm or municipality) at the time of decision may fall within three categories:

1. Sufficient funds are available to purchase equipment outright.
2. Sufficient funds are available for a down payment toward the purchase of equipment.
3. Sufficient funds are available only to initiate a lease agreement.

Leasing firms are hesitant to deal with companies who fall into the last category above.

Assuming sufficient capital is available to enable decision-making solely on the basis of overall cost, Table 1 presents a method of comparing equipment lease versus purchase. From the table it can be seen that a number of variables affect the determination of the most economical alternative. The variables for lease considerations include:

(1) The lease term. Short term leases, less than 3 years, generally favor purchase.

(2) Interest rate. The interest rate of a lease contract is generally greater than that of a sales contract.

(3) The income tax bracket of the lessee, particularly if an individual or partnership, or corporation in considering the equipment.

Outright purchase variables include:

(1) The contract term.

(2) The interest rate.

(3) The interest expense. The interest expense is based upon a "rule of 78" schedule. Scheduling varies with contract life.

(4) The income tax bracket of the purchaser, particularly if an individual, or partnership, or corporation for considering the purchase.

(5) The salvage value.

If upon comparison, the net cash costs are similar, it may be advantageous to lease. This is true because of the smaller initial capital outlay required for a least contract when compared to the down payment required for a purchase contract. Generally, only the first and last months' lease payments are required as an initial leasing charge.

Other factors influencing the decision to lease or purchase include:

TABLE 1

COMPARISON FOR LEASE/PURCHASE OF EQUIPMENT

CASH FLOW CHART - EXAMPLE FOR 5 YEAR TERM

	Lease @ 8% Interest (1)			Sales Contract @ 7% Interest (1)				
Year	Annual Payment (2)	Tax Shelter (3)	Net Cash Cost	Annual Payment	Depreciation (4) 5 Years	Interest Exp. (4,5)	Tax Shelter	Net Cash Cost
1	14,000	7,000	7,000	13,500	9,000	5,865	7,432	6,068
2	14,000	7,000	7,000	13,500	9,000	4,700	6,850	6,650
3	14,000	7,000	7,000	13,500	9,000	3,480	6,240	7,260
4	14,000	7,000	7,000	13,500	9,000	2,160	6,165	7,335
5	14,000	7,000	7,000	13,500	9,000	780	4,890	8,710
		Capital Cost $50,000				Salvage Value @ end of 5 year = $5,000		

1. Interest rate is an "add-on" rate. Thus, to determine the annual payment of either lease or sales contract, the following formula applies:

$$\frac{(\text{add on \% rate}) \times (\text{no. of yrs. of contract}) \times (\text{capital cost}) + \text{capital cost}}{\text{no. of years of contract}} = \text{annual payment}$$

2. Lease payments can be deducted in total as business expenses.
3. Tax shelter based on income tax bracket assumed at 50%.
4. To be decided by lessor/purchaser.
5. Based on "rule of 78", different schedules for different contract terms.
6. Tax shelter is determined by adding depreciation and interest expense and multiplying by the income tax bracket percentage.

(1) Availability of a total warranty plan offered by the lessor. Refuse collection vehicles generally consist of two units, the body and chassis. They are normally manufactured by two separate companies. Each manufacturer warrants its own specific unit. The leasing company may agree to guarantee the vehicle as a whole to the lessee and deal directly with the manufacturers, thus presenting a more attractive package to the prospective lessee.

(2) Purchase options on the leased equipment upon contract termination.

(3) Authorization to modify leased equipment may be difficult to obtain from lessor.

(4) Various contract options, for example, a full maintenance option.

APPENDIX II

EXPERIMENTAL SIDE-LOADER VEHICLE

APPENDIX II

EXPERIMENTAL SIDE-LOADER VEHICLE

COMMERCIAL REFUSE COLLECTION

Background

Two of the more significant time factors in commercial refuse collection are maneuvering the collection vehicle to pick up the container and/or maneuvering the container so the collection vehicle can pick it up. Many front-end loader systems partially solve these problems by locating containers in such a manner that the collection vehicle can service them with a minimum of maneuvering (see Figure II-1, old system). Nevertheless, locating the container in this manner is possible in only a limited number of alleys or properties; and many times the turning radius of the truck necessitates additional maneuvering in order to engage the container. Additionally, elevating the container over the vehicle requires a clearance of about 22 feet, more than is found in many areas. Consequently, the front-end loader has to back up to the right-of-way in order to elevate the containers for dumping.

As part of the EPA Grant, the City of Scottsdale proposed to develop, construct, and test a prototype vehicle that would cycle containers with a side-loading mechanism (see Figure II-3). This vehicle would have shorter cycling time and continuous packing.

Such a vehicle would have two major advantages, one economic and one aesthetic. From an economic viewpoint, the collection vehicle would probably increase productivity 20% compared to existing equipment. Although the truck performs collection in the same manner as the front-end loader, the maneuvering is effectively eliminated because of the side-loading capability (Figure II-2, new system). Additionally, the truck needs to elevate the container only four feet, rather than the fourteen or more feet, required by most front-end loaders, thus, effectively reducing the cycling time per container.

From an aesthetic point of view the containers can now be screened from view by enclosures without being inaccessible to the collection trucks. Thus, alleys no longer have to be the visible repository of refuse containers.

Results

The vehicle was constructed along the design proposed (Figure II-4). During testing and evaluation, however, several design problems became apparent. Driver visibility of the container was less than optimum because of the protective screening and the low height of the engaging forks. Refuse spillage was noted when large or bulky items were dumped into the hopper. Compaction problems were experienced, expecially with bulky cardboard.

The most critical design problem, however, was the weight distribution of the vehicle in relation to the front axle. The legal limit was 18,000 lbs. on the front axle, but the new vehicle carried 21,000 lbs even when it was empty and the packer blade was in the rear of the vehicle. The distribution problem impacted the vehicle in the following manner:

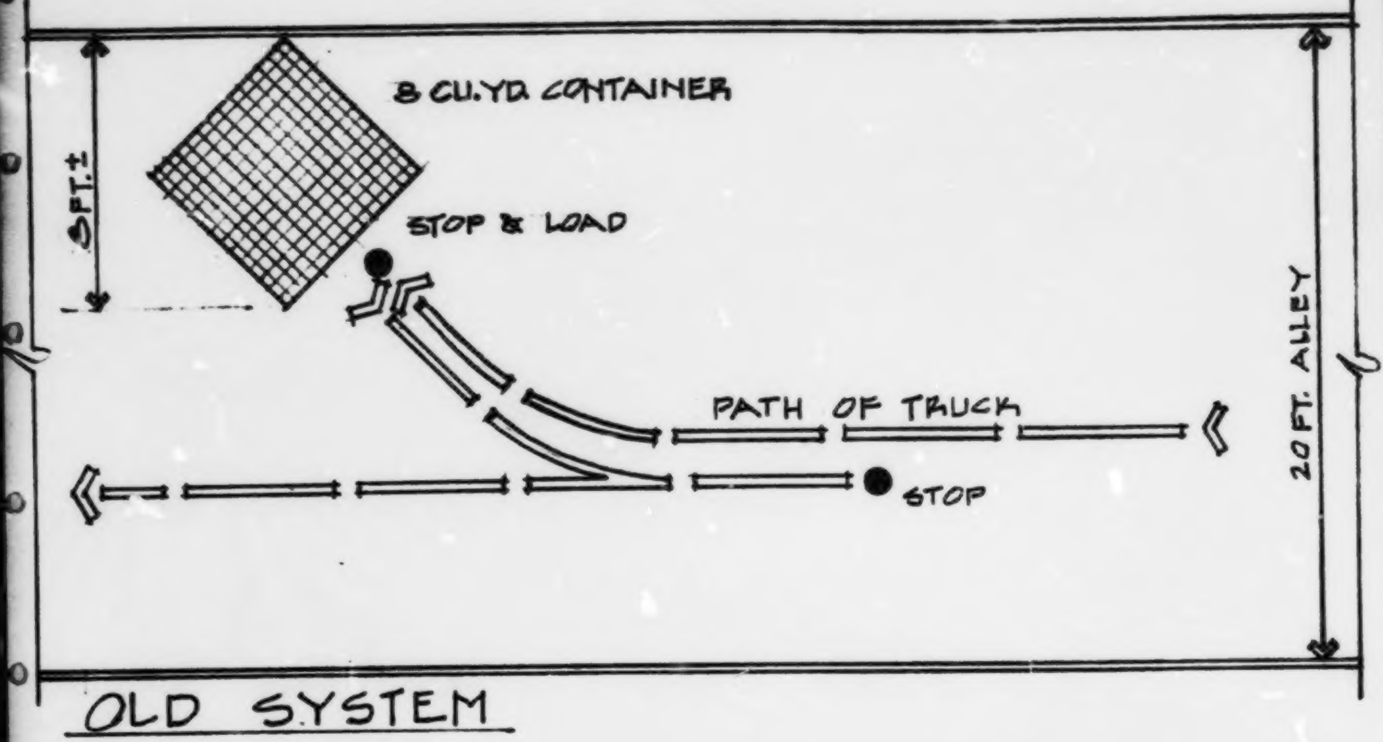

8 CU.YD. CONTAINER
5FT.±
STOP & LOAD
PATH OF TRUCK
STOP
20 FT. ALLEY
OLD SYSTEM

FIGURE II-1. CONVENTIONAL FRONT-END LOADER

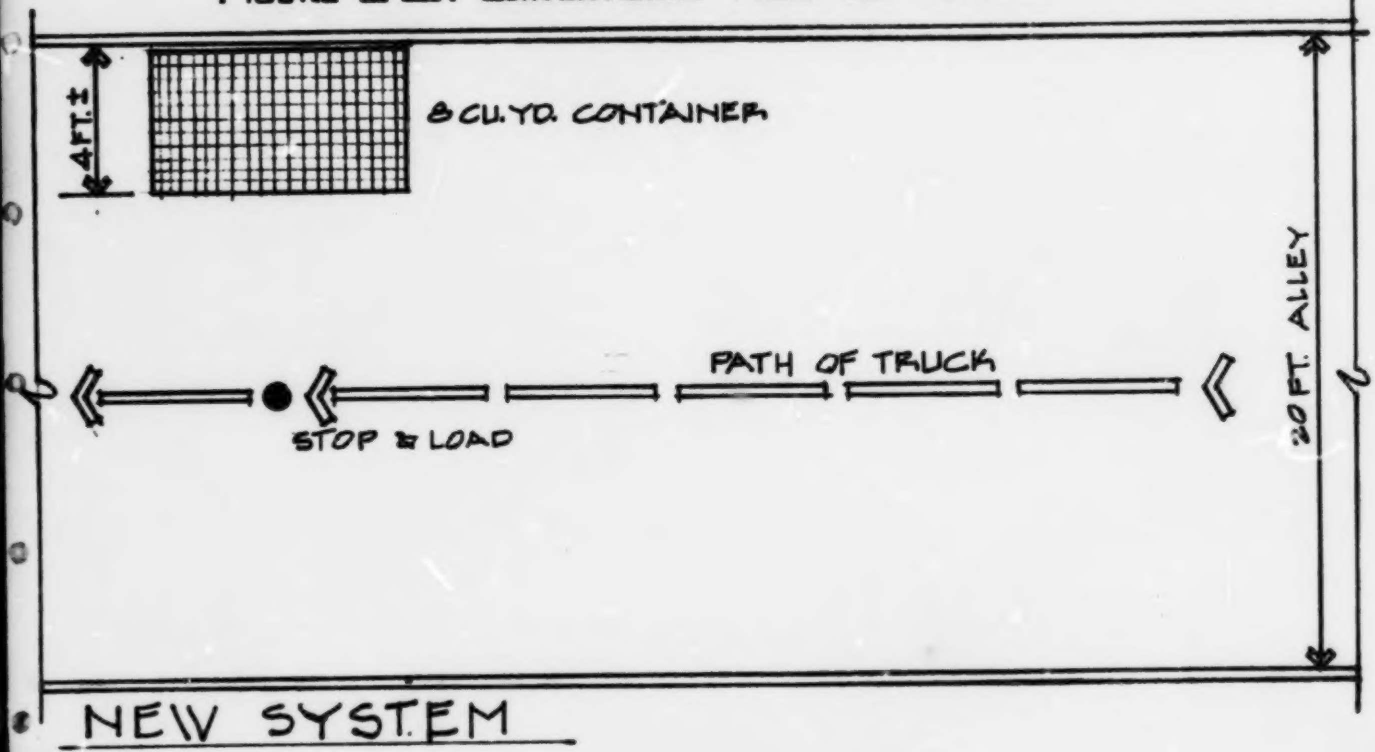

8 CU.YD. CONTAINER
4FT.±
PATH OF TRUCK
STOP & LOAD
20 FT. ALLEY
NEW SYSTEM

FIGURE II-2. EXPERIMENTAL SIDE LOADER

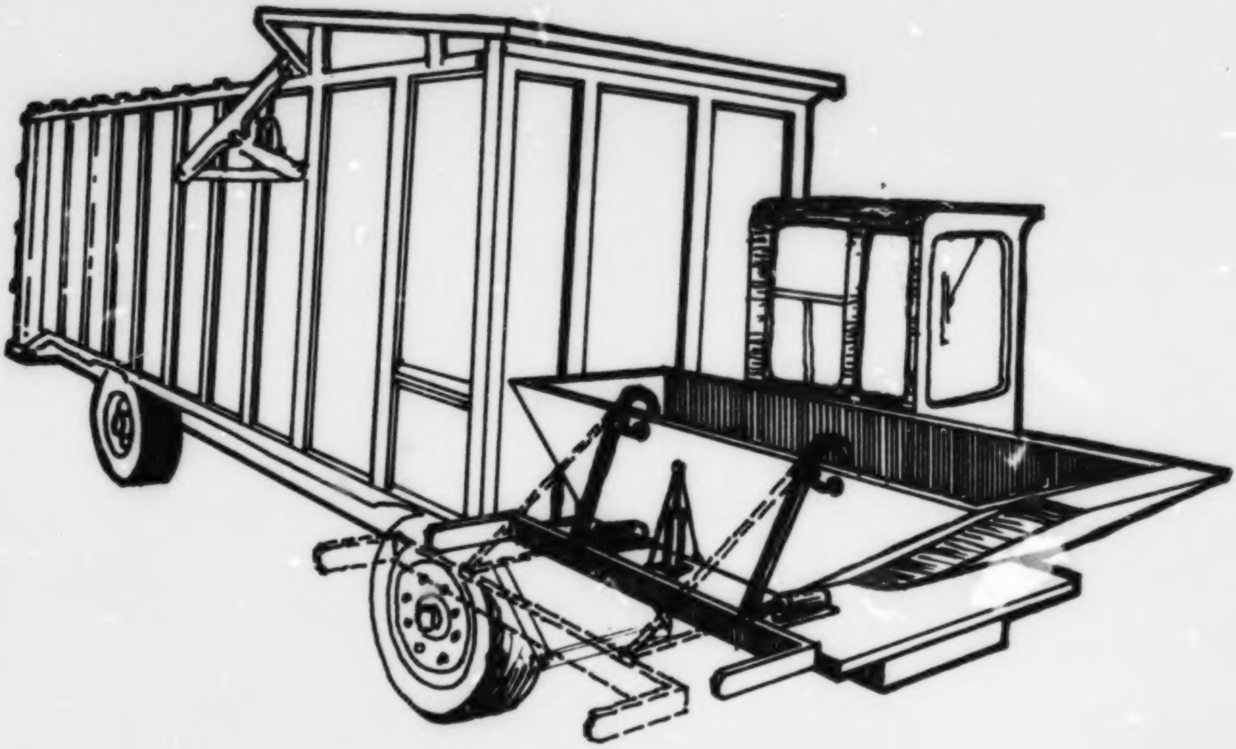


FIGURE II-3.

EXPERIMENTAL VEHICLE DESIGN

1) Steering was extremely difficult because of its excessive front-end weight. On a trip back from Denver the truck went out of control, causing some property damage and narrowly avoiding personal injury.

2) The right front tire may not be able to withstand the weight of both vehicle and container during a pick up cycle. Serious personal injury and equipment damage could result from a blowout.

Conclusion

It was decided that the present design could not be adapted to handle the large commercial containers. The vehicle has been converted to a side-loading residential collection vehicle with a special rail and arm mechanism to lift and empty 80-gallon plastic containers in Scottsdale.

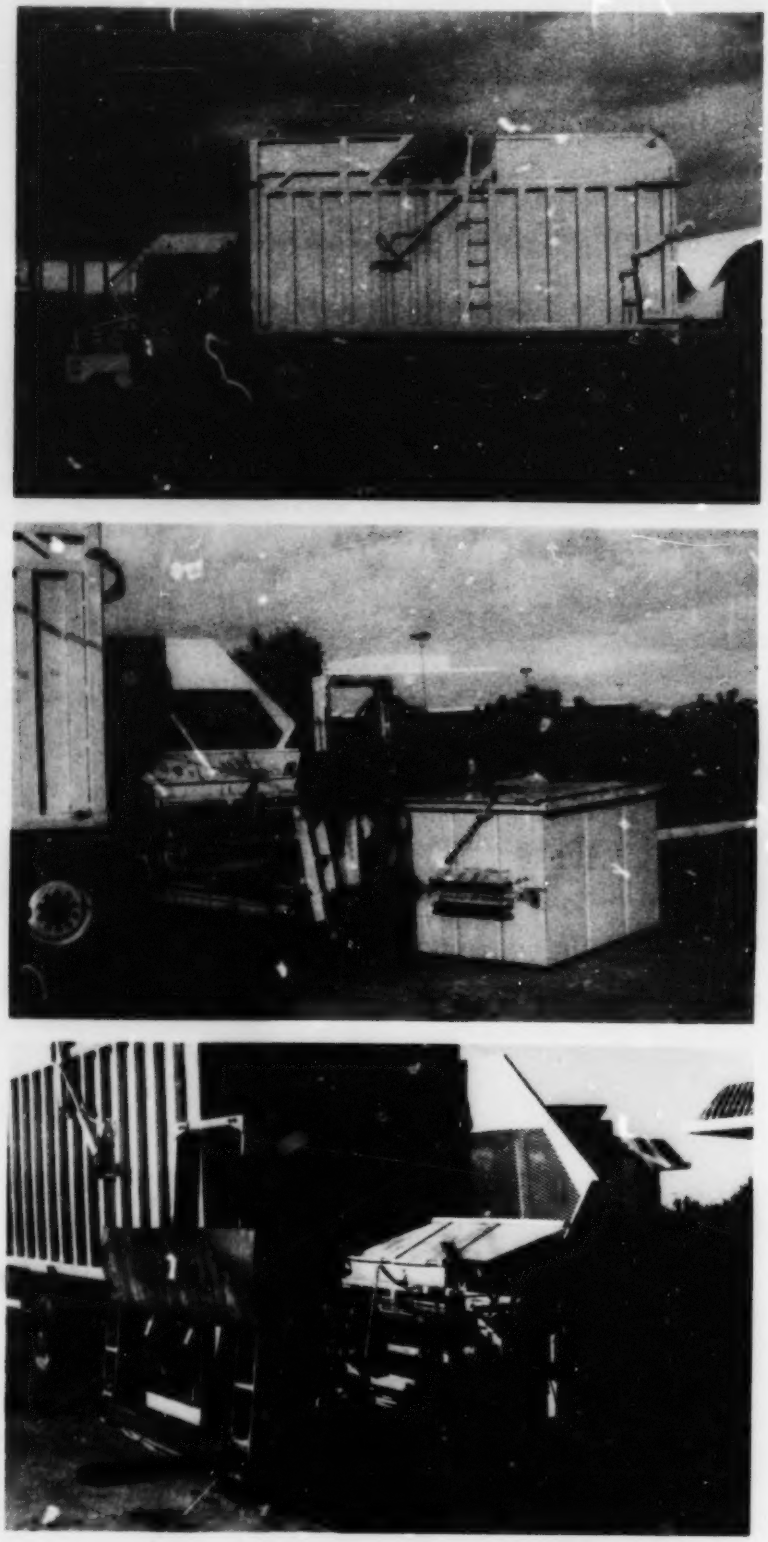


FIGURE II-4 SCOTTSDALE EXPERIMENTAL SIDE-LOADER

APPENDIX III

EQUIPMENT COMPARISON STANDARDS

APPENDIX III

EQUIPMENT COMPARISON STANDARDS

Background

One of the objectives of this Commercial Refuse Collection Study was to develop equipment comparison standards that would "accommodate simple, effective choice of equipment based on ability to perform." It was decided that the most feasible method of meeting this objective would be to present the theoretical and common sense observations concerning collection equipment, and then use Scottsdale as a "case study" to determine the relationships between these observations and reality.

It should be emphasized at the outset that these guidelines should provide an insight into the variables affecting "ability to perform" such that some equipment may be eliminated from consideration and some may seem feasible. At that point it is recommended that the remaining collection vehicles be tested or demonstrated, in the field if possible, to determine the optimum set of equipment for a given route or routes. Experience has shown that equipment selection is one of the most critical aspects of commercial collection, and that proper selection makes a major difference in the success of an operation.

Service Area Characteristics

Obviously the determining factor of equipment value is its ability to perform on a given route having certain characteristics.

The optimum matching of equipment and service area characteristics will produce the greatest productivity at the least cost, a goal common to both private and public haulers.

There are many service area characteristics affecting the optimal selection of vehicles for use in the area. As might be expected, the relative importance of a given characteristic differs somewhat between locations. For example, topography (i.e., steep hills) may be important in one location and not another. Confined maneuvering conditions may be prevalent in one service area, but not in another. Table III-1 is a listing of service area characteristics which may affect the performance of commercial refuse collection vehicles. Table III-2 lists the service area characteristics based on survey time data obtained during field studies in Scottsdale, discussions with public and private collection system managers, and experience of the project participants. It should be pointed out that the single unit against which different systems may be evaluated is time, which can be expressed by simple conversion to dollars.

Additionally, it should not be assumed that service area characteristics are static and interchangeable. Indeed, significant improvements in productivity can be realized by container placement, i.e., locating the container so that it can be picked up, dumped, and put down in position in a minimum time.

Route Related

- Vertical and horizontal clearances
- Topography (grades, curves)
- Length of route
- Distance between collection stops
- Traffic conditions
- Traffic lights
- One-way streets
- Parked cars and other obstacles
- Road surfaces (pavement conditions)
- Legal load limits
- Congestion at disposal site
- Haul distance
- Distance from yard to route
- Frequency of collection
- Time of collection restrictions

Container Related

- Number at each stop
- Number on route
- Size
- Castered or not
- Empty weight
- Covered or not
- Percent utilization
- Accessibility to vehicle
- Vertical and horizontal clearance

Climate Related

- Wind
- Cold temperature
- Snow or ice conditions
- Rain
- Hot temperature

Waste Material Related

- Compactability
- Maximum dimensions
- Variations in quantity
- Hazardous materials

TABLE III-1

SERVICE AREA CHARACTERISTICS
AFFECTING THE PERFORMANCE OF REFUSE COLLECTION
VEHICLES

Route Related

- Vertical and horizontal clearances
- Topography (grades, curves)
- Distance between collection stops
- Legal load limits
- Haul distance

Container Related

- Number on route
- Size
- Castered or not
- Accessibility to vehicle

Climate Related

- Wind
- Extreme temperatures
- Precipitation (rain, snow, etc.)

Waste Material Related

- Compactibility
- Maximum dimensions

TABLE III-2. SERVICE AREA CHARACTERISTICS MOST IMPORTANT TO EQUIPMENT SELECTION

Service Area & Vehicle Relationships

Table III-3 lists example questions to be considered where matching service area and equipment performance characteristics. The prospective equipment purchaser must weigh the importance and the cost of each characteristic to the total system. To assist in that process the following pages detail each major characteristic and the methods to be used in evaluating it.

Comparison Specifics

(1) Vertical and Horizontal Clearances

Narrow alleys, numerous parked cars and low clearances due to trees and power lines may constrain vehicle dimensions and/or loading method. Among the questions which must be answered are the following:

a. What are the minimum vertical and horizontal clearances affecting the collection vehicle on the route? Front-loading vehicles elevate containers for dumping. Thus, the overall height of both vehicle and container must be considered. Side-loading vehicles require additional width during loading for container lifting movements.

b. What are the maximum state limits on vehicle dimensions? Maximum tabulated dimensions may be exceeded while the vehiclc is loading containers, but not when traveling to and from the disposal site on state highways. Thus, local regulations should also be checked. (Table III-4 presents state regulatory limits).(1)

---

(1) Solid Waste Management Refuse Removal Journal, V16, No. 13, December, 1973, pg. 56.

Service Area Characteristic/Question	Related Equipment Factors
Vertical & horizontal clearances	
Are difficult maneuvering conditions present, e.g., sharp turns, narrow alleys, low clearances, heavy traffic?	1. Vehicle dimensions 2. Turning radius
Topography	
Are hills significant?	1. GVW/HP ratio 2. Transmission (auto or manual) 3. Engine type (diesel or gasoline)
Distances between customers	
Are collection stops widely scattered or in a dense area?	1. Vehicle type (side or front loading) 2. Transmission (auto or manual)
Legal Load Limits	
Are legal load limits imposed?	1. Vehicle capacity 2. Axle loading 3. Compaction force
Haul distance	
Is travel time from the route to the disposal site a significant consideration, e.g., over 20 min one way?	1. Vehicle capacity
Number of containers on route	
Are there many containers (over 100) or a few (20)?	1. Loading cycle time 2. Compaction cycle time 3. Auxiliary engine
Container Sizes	
What size containers are to be collected?	Lift mechanism capacity

TABLE III-3. COMPARING COMMERCIAL REFUSE COLLECTION EQUIPMENT

Service Area Characteristic/Question	Related Equipment Factors
Container types	
What types of containers are to be collected? Are the containers equipped with casters?	1. Loading method (side or front) 2. Lift mechanism type and capacity
Container accessibility	
Are containers readily accessible?	Loading method (side or front)
Wind	
Are windy conditions significant?	Loading method (side or front)
Cold temperatures	
Will temperatures enable refuse to freeze in the vehicle?	Dumping method (tilt-body or push-out)
Waste Materials	
Are bulky wastes to be collected?	1. Dimensions of vehicle hopper opening 2. Compaction force

TABLE III-3 CONTD.

State	Height ft-in.	Width in.	State	Height ft-in.	Width in.
Alabama	13-6	96	Missouri	13-6	96
Alaska	13-6	96	Montana	13-6	102
Arizona	13-6	96	Nebraska	13-6	96
Arkansas	13-6	96	Nevada	14	96 B2
California	14	96 B1	New Hampshire	13-6	96
Colorado	13-6 A1	96	New Jersey	13-6	96
Connecticut	13-6	102	New Mexico	13-6	96 B3
Delaware	13-6	96	New York	13-6	96
District of Columbia	12-6	96	North Carolina	13-6	96
			North Dakota	13-6	96
Florida	13-6	96	Ohio	13-6	96
Georgia	13-6	96	Oklahoma	13-6	102 A2
Hawaii	13-6	108	Oregon	13-6	96 B1
Idaho	14	96	Pennsylvania	13-6	96
Illinois	13-6	96	Rhode Island	13-6	102
Indiana	13-6	96	South Carolina	13-6	96
Iowa	13-6	96	South Dakota	13-6	96
Kansas	13-6	96 B2	Tennessee	13-6	96
Kentucky	13-6 A1	96	Texas	13-6	96
Louisiana	13-6	96	Utah	14	96
Maine	13-6	102 A2	Vermont	13-6	96
Maryland	13-6	96	Virginia	13-6	96
Massachusetts	13-6	96	Washington	13-6	96
Michigan	13-6	96	West Virginia	13-6 A1	96
Minnesota	13-6	96	Wisconsin	13-6	96
Mississippi	13-6	96	Wyoming	14	102 A2

General
A1 - On designated highways
A2 - Except on interstate system

Width
B1 - 100" across tires
B2 - 102" across tires
B3 - 102" on designated highways

TABLE III-4. SUMMARY OF STATE LIMITS ON VEHICLE DIMENSIONS

c. Assuming a vehicle can negotiate the minimum clearance, what is the probable time loss due to low or narrow clearance locations in the service area? Collection vehicle maneuverability is a function of vehicle size, turning radius, and turning area constraints. The vehicle characteristics which govern maneuverability are: wheelbase, axle track, overall width, front overhang, rear overhang, turning angle, side overhang, steering. These characteristics are diagrammed for a collection vehicle in Figure III-1.

As a general guide, Table III-5 identifies the minimum road widths that various assumed vehicles can negotiate without backing or maneuvering, assuming the intersection angle to be 90°.

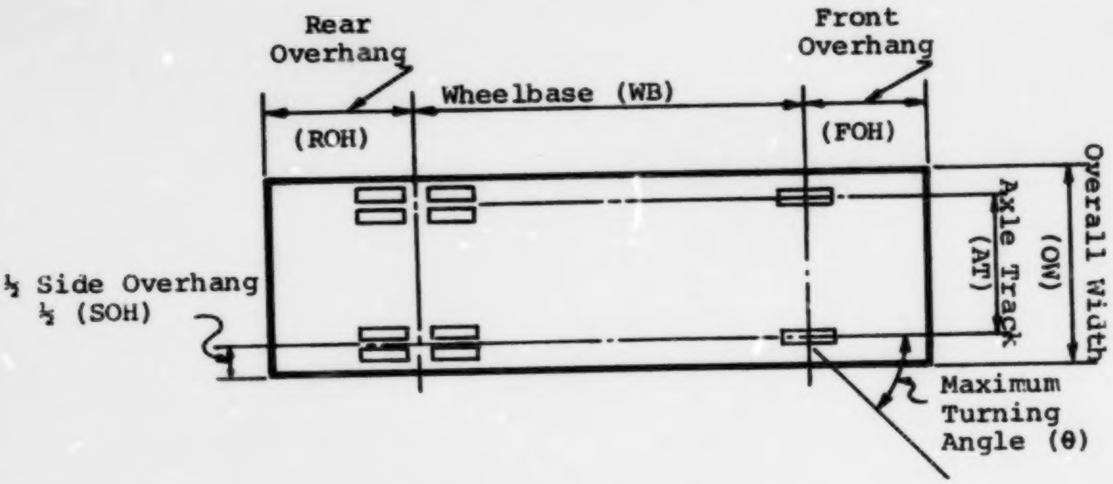
TABLE 5

VEHICLE TURNING CHARACTERISTICS

Vehicle	OL	WB	ROH	FOH	Road Width Minimum (ft)
A	361	220	87	54	18.5
B	359	183	115	64	18.0
C	373	190	115	68	18.5
D	324	186	87	51	17.0
E	312	163	97	53	16.5
F	298	149	120	53	15.5
G	245	125	67	52	14

Key:
OL = total overall length
WB = wheel base
ROH = rear overhang
FOH = front overhang

Note: In all examples, the initial travel boundary is assumed equal to the final travel boundary.

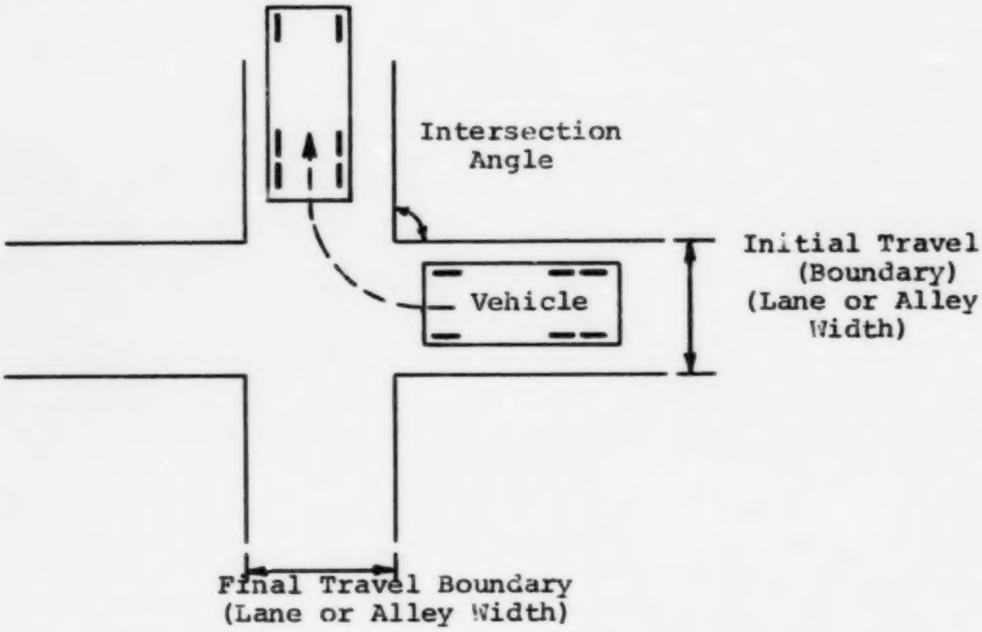


Rear Overhang
Front Overhang
Wheelbase (WB)
(ROH)
(FOH)
Overall Width (OW)
Axle Track (AT)
½ Side Overhang
½ (SOH)
Maximum Turning Angle (θ)

FIGURE III - 1

VEHICLE CHARACTERISTICS

When determining the sharpest turn that can be negotiated, the angle between the streets (usually 90°) and the street widths are also key factors to consider. See diagram below:



Intersection Angle
Vehicle
Initial Travel (Boundary) (Lane or Alley Width)
Final Travel Boundary (Lane or Alley Width)

The purchaser can measure the intersection angle and the corresponding street widths at several critical locations in his service area.

For more detailed analysis of vehicle dimension and turning characteristics, see attachment 1 at the end of this appendix.

(2) Topography

Hills or road grades can reduce the speed of equipment travel. In general, hilly service areas or those characterized by roads having long and/or frequent grades are best served by vehicles with lower GVW/HP ratios.

a. Automatic vs. Manual Transmission. Refuse collection operations generally favor automatic transmissions because of safety and simplicity of operation. Some users claim they reduce maintenance costs.(2) In hilly terrain, the automatic transmission is even more advantageous due to the increased frequency of gear changes. Efficiency of vehicle operation is improved because the proper gear ratio is automatically selected. However, in areas with minimal grades, the cheaper manual transmissions may still be useful and less costly.

b. GVW/HP Ratios. Figure 2 displays the maximum sustainable speed of vehicles operating on grades of varying degrees. As can be seen, vehicles with lower GVW/HP ratios can sustain higher speeds on grades. Analytical techniques and necessary assumptions for deriving the curves shown are contained in attachment 2 at the end of this appendix. Calculations were made for two representative vehicles and results shown on the figure.

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(2) Manual Shifts Vs. Automatic, APWA Reporter, September 1973, pg. 24.

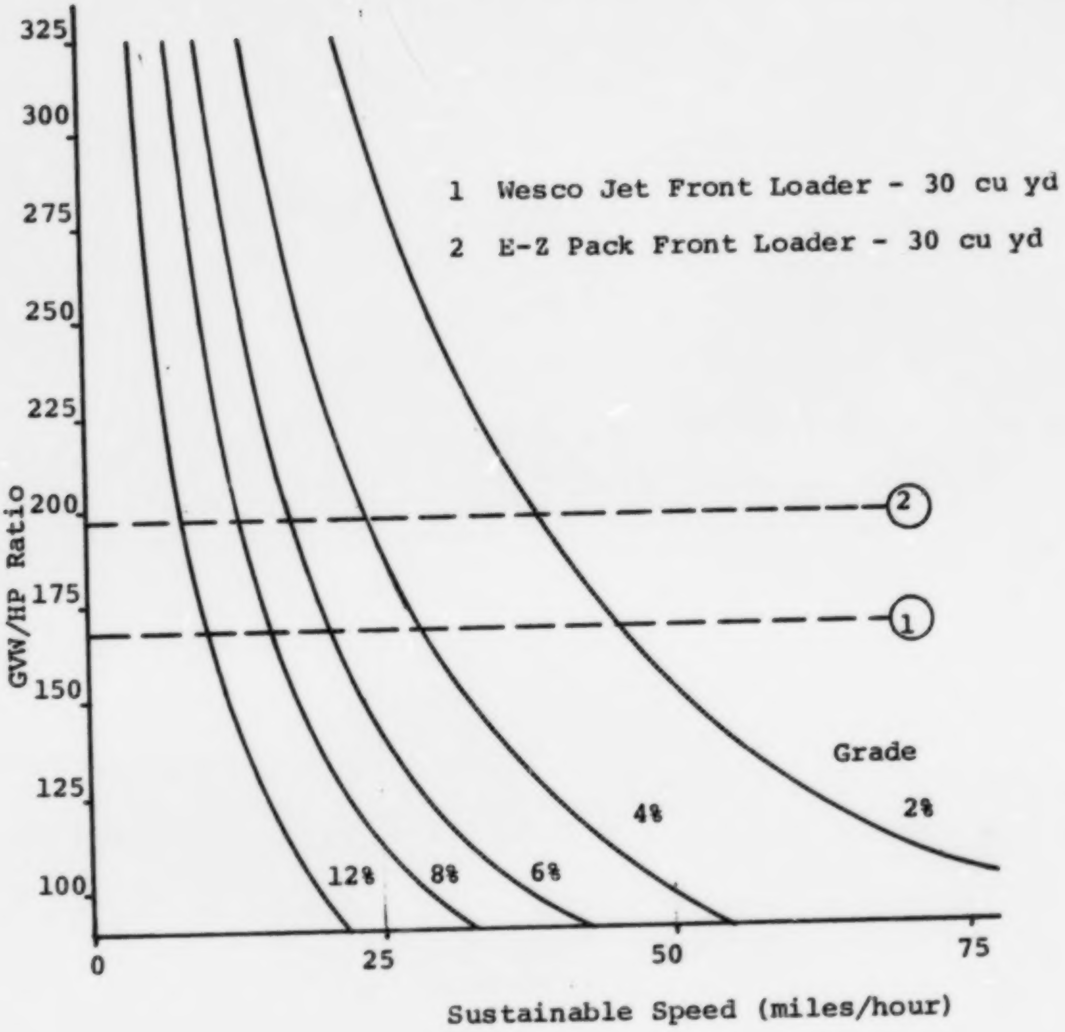

Figure III-2

Gradeability of Collection Vehicle

c. Fuel Consumption. Fuel consumption may increase as the GVW/HP ratio is reduced. Gear ratios and driver capability also affect fuel economy. The vehicle manufacturer can be requested to supply average fuel consumption data for his vehicle under specified conditions. For example, with full and empty load, the manufacturer could supply average fuel consumption data for the vehicle when operated at 40 mph at sea level.

d. Engine Type. Diesel engines typically develop their maximum horsepower at a lower rpm than gasoline engines. The torque curve is flatter and enables these engines to perform better in hilly conditions. Fuel economy of the diesel is also superior to the gas engine. The supply of diesel fuel should be researched before any decision on engine type is reached.

(3) Distance Between Customers

The number and frequency of collection stops along the route may influence the decision as to which type of truck to use, front-or side-loading.

a. Front Vs. Side-Loading Vehicles. If containers can be properly located with access to a front-loader vehicle, the driver can contact, lift, and empty the container without leaving the cab of the vehicle. The obvious advantage in speed of collections and reduced driver fatigue becomes increasingly important as distance beween customers along a given route decreases, since one-man side-loading operations require the driver to leave the cab, roll the container to and from the truck, and return to the cab. The advantage of the front-end loader vehicle is reduced somewhat if containers are not directly accessible to the vehicle, thereby requiring the driver to maneuver the container to the loading mechanism.

(4) Load Limits

Some collection vehicles with either highly efficient compaction mechanisms or when used for collecting heavy waste, can become overloaded. Vehicle capacity which cannot be used without overloading is of little or no value. State regulations governing vehicle loads are summarized in Table 6.(1)

a. Weight Capacity

Limited studies in Scottsdale have shown that despite variances in the initial loose density of the refuse, the compacted density in the vehicle approximates 600 lbs. per cu. yd., based on the conceptualized curve shown in Figure III-3. Thus, in Scottsdale, a 30 cubic yard capacity truck may be expected to hold 18,000 pounds. These amounts, while applicable only to Scottsdale, show the general relationship between density and weight.

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(1) Solid Waste Management Journal, V.16, No. 13, December 1973, p. 56.

State	Axle Load Limits (lbs) Single	Axle Load Limits (lbs) Tandem 4 ft Apart	Gross Weight Limits (lbs) Maximum Allowable GCW	Gross Weight Limits (lbs) Use Formula or Tables at end of summary
Alabama	18,000 E5	36,000 E5	73,280	T
Alaska	20,000 D2	34,000	108,500	T
Arizona	18,000	32,000	76,800	T
Arkansas	18,000	32,000	73,280	-
California	18,000	32,000	76,800	T
Colorado	18,000	36,000	85,000 A2	F5
Connecticut	22,400 D4;E1	36,000 E1	73,000	-
Delaware	20,000	36,000	73,280	T
District of Columbia	22,000	38,000	70,000	T
Florida	20,000 E5	40,000 E5	73,271	T
Georgia	18,000 E6	36,000 E6	73,280	-
Hawaii	24,000 D8	32,000	73,280	T
Idaho	20,000 D7	34,000	105,500 A2	-
Illinois	18,000 E8	32,000 E8	73,280 E8	T
Indiana	18,000 D7;E8	32,000 E8	73,280 E8	-
Iowa	18,000 E2	32,000 E2	73,280	T
Kansas	20,000 A2	34,000 A2	85,500 A2	T
Kentucky	18,000 D4;E3	32,000 E3	73,280 A1	-
Louisiana	18,000 D1	32,000	73,280	-
Maine	22,000 D4	36,000 A1	73,280	T
Maryland	22,400	40,000	73,280	T
Massachusetts	22,400 D7	36,000	73,000	T
Michigan	18,000 D6;G4	26,000 G4	136,000 A1	-
Minnesota	18,000	32,000	73,280	T
Mississippi	18,000 D9	32,000 A1	73,280 A1	T
Missouri	18,000	32,000	73,280	T
Montana	18,000 G3	32,000 G3	76,800 G3	T
Nebraska	18,000 E3	32,000 E3	95,000 A1;E2	T
Nevada	18,000	32,000	76,800	T
New Hampshire	22,400 D4	36,000	73,280	T
New Jersey	22,400 D7;E3	32,000 E3	73,280	T
New Mexico	21,600 D4	34.320	86,400	T
New York	22,400 D7	36,000	73,280	F3
North Carolina	18,000 D4;E7	36,000 D7	73,280	-
North Dakota	20,000 D3;A1	32,000	73,280 A3	F1
Ohio	19,000 D5;E2	32,000 G1;E2	78,000	F4
Oklahoma	20,000 D5;A2	34,000 A2	90,000 A2	T
Oregon	18,000 D3;G2	32,000 G2	76,000 A3;A1	T
Pennsylvania	22,400 D7	36,000	73,280	-
Rhode Island	22,400	NS	73,280	-
South Carolina	20,000	36,000 A2	73,280	-
South Dakota	20,000 A2	34,000 A2	95,000 A2	T
Tennessee	18,000	32,000	73,280	-
Texas	18,000 D5;E3	32,000 E3	72,000	T
Utah	18,000	33,000	79,900	T
Vermont	22,400 D4;E3	36,000 E3	73,280	T
Virginia	18,000 D5	32,000	70,000	T
Washington	18,000 D3	32,000 G5	76,000 A3	T
West Virginia	18,000 E3	32,000 E3	73,280 A1	T
Wisconsin	19,500 A1	32,000	73,000	T
Wyoming	20,000 A1	36,000	101,000	T

TABLE 6. SUMMARY OF STATE LIMITS ON VEHICLE LOADING

General

A1 - On designated highways
A2 - Except on interstate system
A3 - With permit
NP - Not permitted
NR - Not restricted
NS - Not specified
T - Tables may be obtained from State Motor Vehicle Administrators

Tire Weight Limits

D1 - 450 lbs
D2 - 500 lbs
D3 - 550 lbs
D4 - 600 lbs
D5 - 650 lbs
D6 - 700 lbs
D7 - 800 lbs
D8 - 60 lbs per sq in. of tire contact area
D9 - On tires 9:75 & larger

Weight Tolerances

E1 - Plus 2% tolerance
E2 - Plus 3% tolerance
E3 - Plus 5% tolerance
E4 - Plus 8% tolerance
E5 - Plus 10% tolerance
E6 - Plus 13% tolerance
E7 - Plus 1,000 lbs on each axle
E8 - Overload up to 1,000 lbs not a violation

Formulas

L = Distance from foremost to rearmost axles.

F1 - Formula 750 (L + 40)
F2 - Formula 800 (L + 40)
F3 - Formula 34,000 + (L x 1,000)
F4 - Formula 38,000 + (L x 900)
F5 - Formula 38,000 + (L x 900)

Weight Exceptions

G1 - 24,000 lbs with tandem axles spaced less than 48 inches apart.
G2 - 20,000 lbs on single axle and 34,000 lbs on tandem on State Highways only.
G3 - 20,000 lbs on single axle; 34,000 lbs on tandem axle; 105,500 lbs total gross with permit.
G4 - 13,000 on a single axle if spaced between 3 1/2 feet and 9 feet apart; 32,000 lbs on one tandem per combination on designated highways or 32,000 lbs.
G5 - 36,000 lbs if spacing is 102 in. min. between axles.

TABLE 6 - CONTD.

As densities vary from season to season, type of refuse collected, and compaction capability of the vehicle, it is important to maintain full load records for each truck. This amount, when added to the vehicle weight, must not exceed the maximum allowable weight as set forth in Table 6.

b. Compaction Capability

Vehicle compaction capability is measured in various ways. Many manufacturers advertise the total force (lbs) exerted by the packing mechanism on the refuse or the maximum pressure in the packing cylinder. A better measure of compaction capability is the force applied per unit of area (lbs per sq in.) on the refuse (not in the hydraulic cylinder). Figure III-3 shows how compaction should vary between vehicles having different compaction pressure. Equipment manufacturers can provide weight distribution data useful in calculating gross vehicle weight when loaded, and individual axle loadings.

(5) Haul Distance

As haul distances and travel times from the route to the disposal site increase, the proper selection of vehicle size (cu yd capacity) becomes increasingly important. Each time the vehicle is filled, it must make a round trip to the disposal site. The haul time reduces the time the vehicle has for completing its primary function--collection of refuse. The solutions to this problem are larger capacity trucks and/or transfer stations.

a. Larger Capacity Trucks. Figure III-4 provides an example of how "loads per day" is affected by equipment capacity. In this example, the 32 cu yd truck makes more efficient use of the available collection time than the 25 cu yd

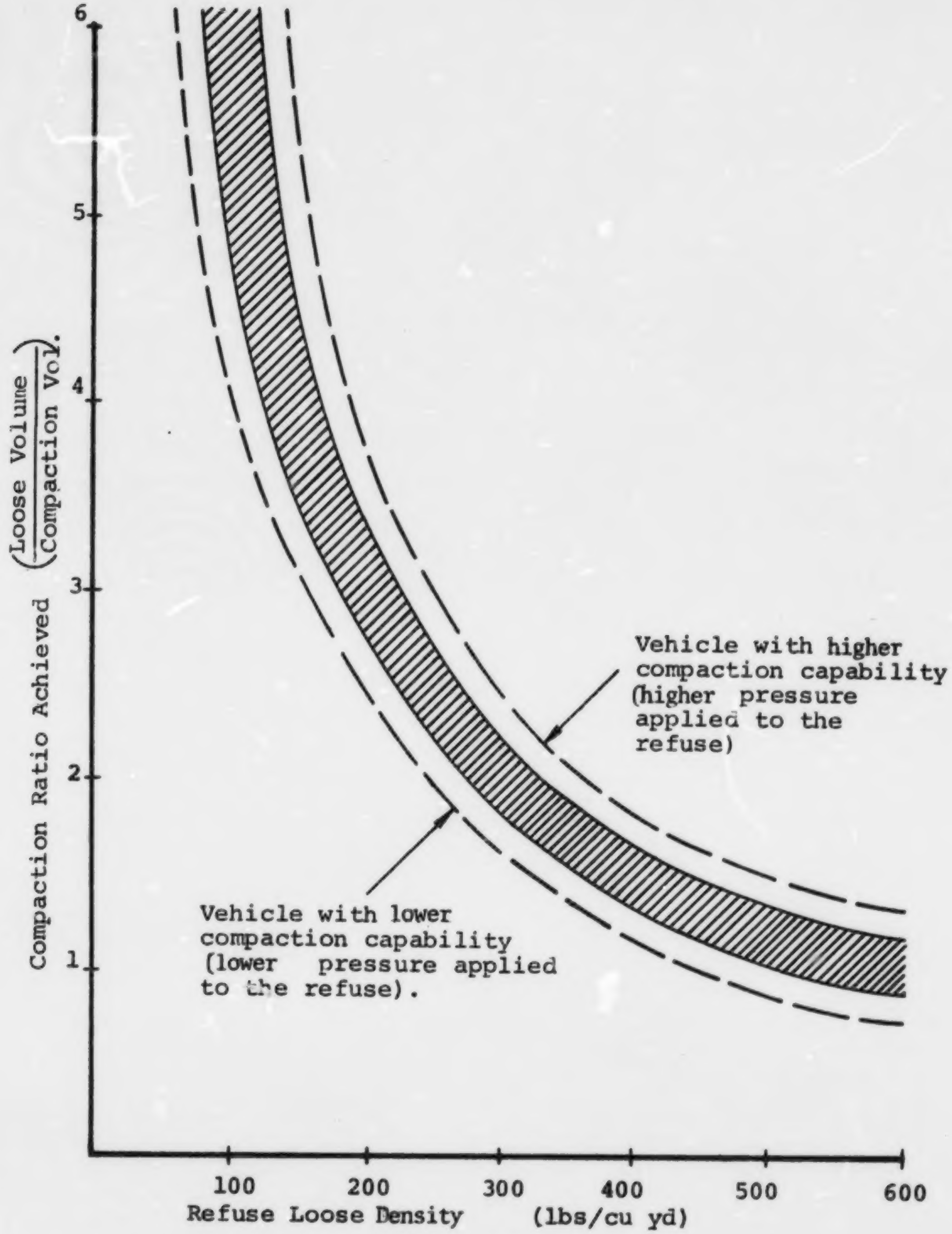


Figure III-3
Compaction Achieved Versus Refuse Loose Density
(Conceptual)

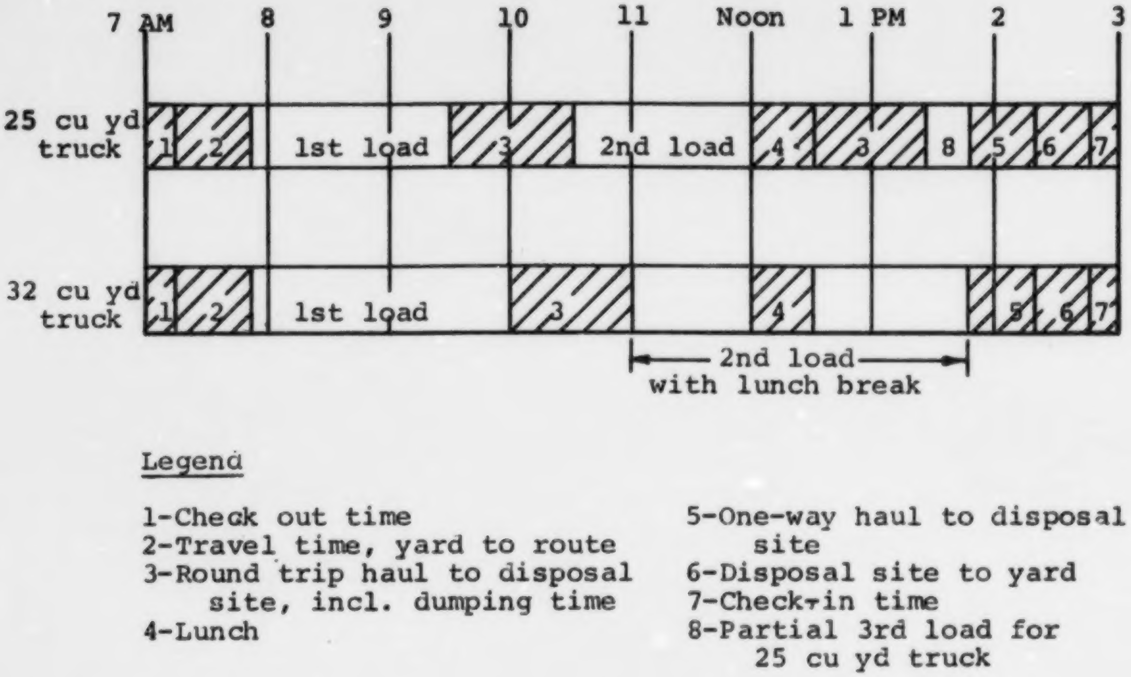
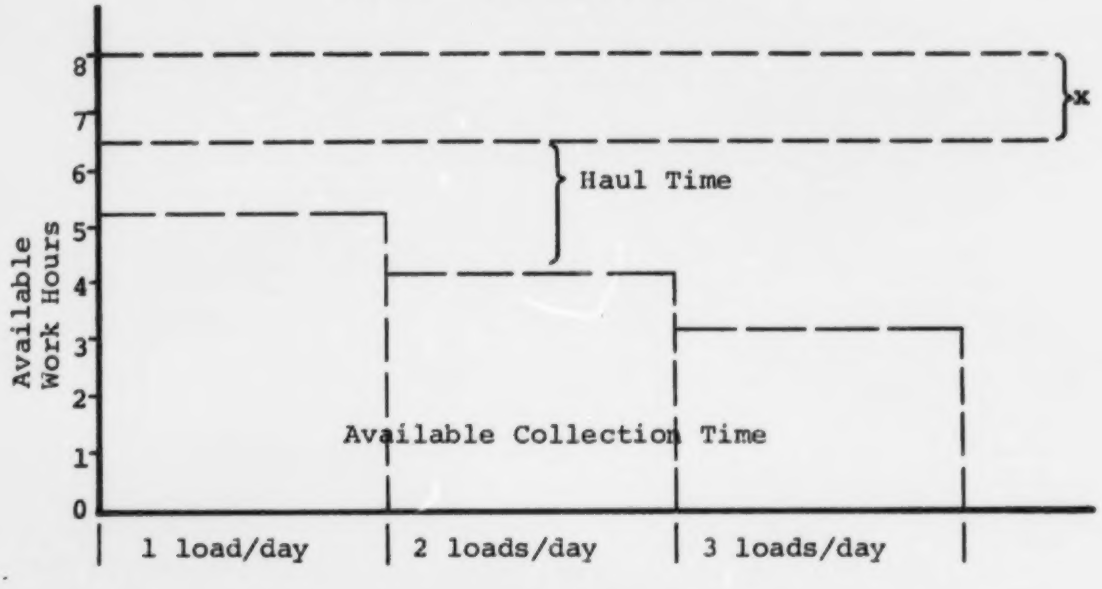

7 AM
8
9
10
11
Noon
1 PM
2
3
25 cu yd truck
1
2
1st load
3
2nd load
4
3
8
5
6
7
32 cu yd truck
1
2
1st load
3
4
5
6
7
2nd load with lunch break
Legend
1-Check out time
2-Travel time, yard to route
3-Round trip haul to disposal site, incl. dumping time
4-Lunch
5-One-way haul to disposal site
6-Disposal site to yard
7-Check-in time
8-Partial 3rd load for 25 cu yd truck

FIGURE III-4
COMPARATIVE SCHEMATIC OF COLLECTION
VEHICLE TIME UTILIZATION



x: Total time for check out, lunch, yard to route travel and disposal site to yard travel.

FIGURE III-5
EFFECT OF HAUL ON COLLECTION TIME

truck, since it is able to collect and dispose of two full loads totaling 64 cu yds during the eight-hour day. The smaller truck can collect only about 55 cu yds and must make an additional trip to the disposal site. Allowable axle loadings and maneuverability requirements limit capacity on most commercial refuse collection vehicle to 32-40 cubic yards. Truck capacity, hours worked, and cubic yards per hour need to be explored in order to determine optimum size.

b. Transfer Stations

A number of different types of stations are available and in operation, ranging from simply transferring the refuse into a larger truck to dumping the refuse into a shredder, performing preliminary resource recovery operations, and baling the residue. These systems should be examined if travel time to and from the landfill is significant. As Figure III-5 indicates, the available time for collection is reduced each time a trip to the disposal site must be made. Attachment 3 briefly describes the system used in Scottsdale and its economics.

(6) Number of Containers on the Route

Modern collection equipment can service 150 or more containers in one day. Thus, small time savings at each container can be multiplied and thereby become significant.

a. Servicing a Container. The elapsed time at each customer is a function of the time to complete the following activities:

(1) Maneuvering into positon and engaging the container

(2) Lifting, emptying and replacing the container

(3) Compacting the refuse (optional)

(4) In some cases or methods, rolling out the container to and from the customer's site

Lifting, emptying and replacing the container comprise the "loading cycle time" for a given vehicle. This time becomes increasingly important as the number of containers to be serviced increases. For example, assume a particular route has 150 containers to be serviced each day. If Vehicle A has a loading cycle time of 25 seconds, while Vehicle B has a loading cycle time of 45 seconds, the total loading time for Vehicle A would be (150 containers) x 25 seconds/container) = 63 minutes, whereas Vehicle B's comparative time would be (150 containers) x 45 seconds/container) = 113 minutes. Thus, due to a loading cycle time differential of only 20 seconds. Vehicle A gains 50 minutes over Vehicle B during the course of serving a 150 container route.

b. Compaction Time. Compaction is achieved by either of two methods. If the vehicle is equipped with an auxiliary engine or a parallel PTO, compaction can be performed while the vehicle is proceeding to the next customer. Thus, the time to compact is actually included within necessary travel time between customers. However, if the above equipment is not used, compaction must be actuated while the vehicle is stationary, usually immediately after loading.

As was the case with the loading cycle time, the importance of compaction cycle time (with no auxiliary engine) increases on routes having many containers.

(7) Container Size

The cost of servicing a customer's account can be minimized if the frequency of collection and the number of container used by the individual customer are both minimized. This implies the use of the largest container possible, as illustrated in Figure 6.

a. Equipment Lifting Capacity. The vehicle lift mechanism must be capable of safely handling the heaviest loaded containers found in the service area. Some industrial wastes and wastes with high water content, either inherent in the particular waste or due to climate, will be heavier than normal dry refuse. The increased weight must be considered when determining required lift mechanism capacity. On the average, loose commercial refuse weighs on the order of 200 lbs. per cubic yard, but may weigh up to 800 lbs. per cubic yard in some isolated cases.

(8) Container Type

New equipment must be capable of servicing existing waste storage containers (if any) utilized in the service area. Obviously, this requirement points to the value of maintaining records on and using standardized container types and sizes. Use of side-loading equipment almost always requires manual positioning of the container for dumping. Front-loading equipment can often operate without the need for manual container positioning, as previously discussed. Casters on bins are, therefore, a necessity for bins to be

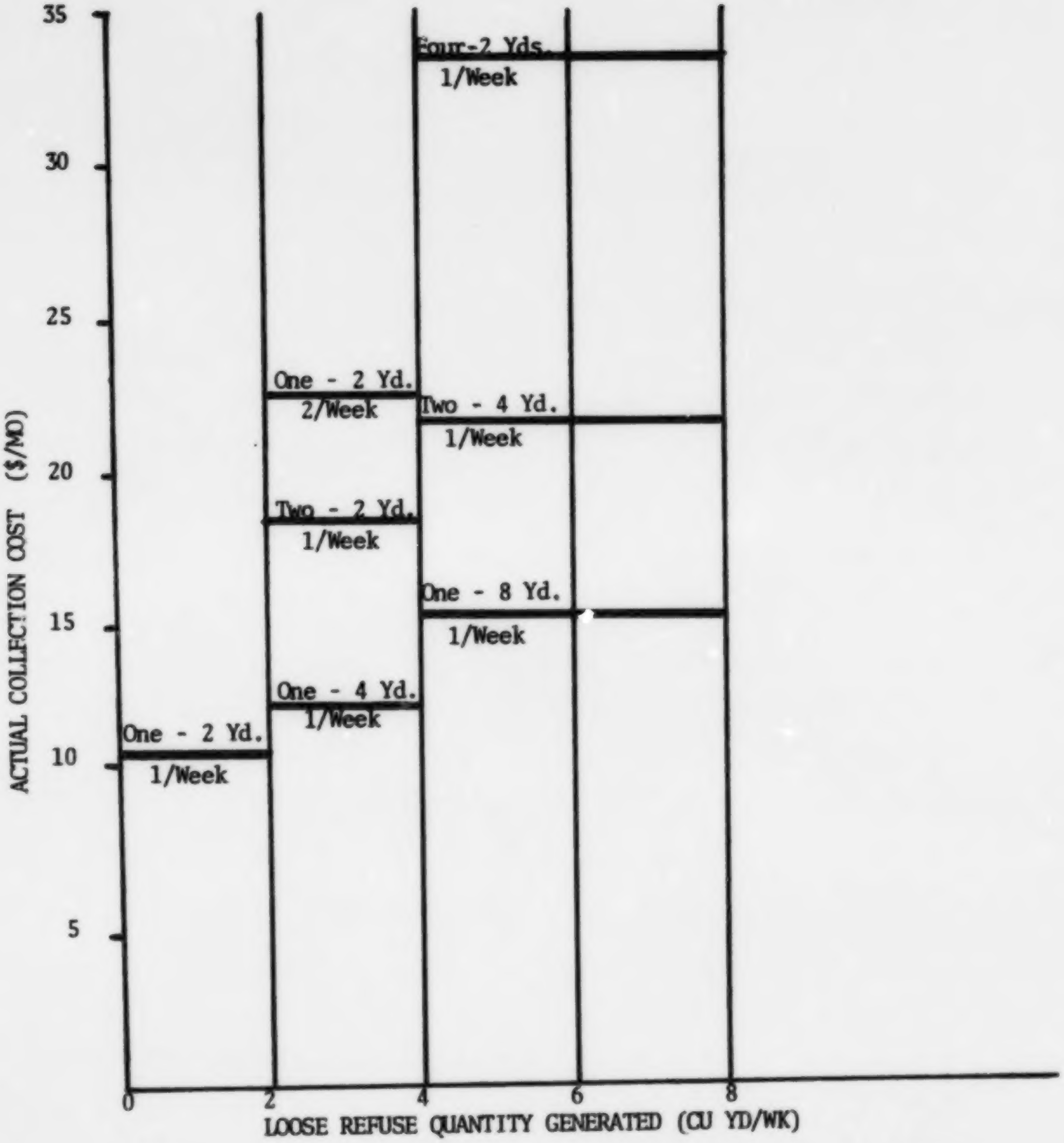


FIGURE 6. CONTAINER SIZE & COLLECTION FREQUENCY COST RELATIONSHIPS

side-loaded, whereas they may not be needed on all bins to be front-loaded. Converting from a front- to side-loading vehicle may therefore necessitate container replacement, modification, or the addition of casters to existing containers. A set of four casters installed on a container costs at least $50.00.

(9) Container Accessibility

Proper location of containers, especially with front-end loading equipment, is the single most critical factor affecting time on commercial collection routes. Both front-end and side-loading equipment can and should be specified such that dumping controls are conveniently located on the exterior of the vehicle.

(10) Wind

If high, gusty winds occur frequently in the service area, front-loading vehicle may be more susceptible to blowing litter than side-loading models. It is sometimes possible for winds to blow refuse away as it falls from the container into the vehicle body during the front-end dumping operation. The more confined nature of the side-loading operation partially eliminates this problem through shielding.

(11) Cold Temperatures

Air temperatures below freezing (32°F) may cause some refuse to freeze and lodge in the vehicle body. If such conditions are prevalent, it is obviously advantageous to use the hydraulic push-out method for emptying the vehicle as opposed to the tilt and gravity dump method. Problems of frozen loads are much more prevalent where partial loads are left in the vehicle overnight rather than being emptied.

(12) Waste Materials

If large, bulky wastes protrude from conttainers, it is important that the vehicle hopper opening be of sufficient size to accept the waste without the bulky items jamming or falling over the side of the vehicle. Resulting spillage delays the progress of the collection vehicle and can give rise to customer complaints.

Container sizes at customer locations discarding bulky wastes can be increased to better contain the wastes. Stationary compactors can also be employed to compact the waste prior to collection.

As previously discussed, the compaction force applied by the vehicle can be important in properly sizing equipment for given service area. Once bulky wastes are inside the vehicle body, a vehicle having a higher compaction force (in terms of the applied pressure per square inch on the waste) will achieve a better volume reduction on the waste material.

Conclusion

A number of service area characteristics can be seen to affect equipment performance and selection. Some are more important than others depending on service area requirements. After eliminating the equipment that cannot meet essential requirements (size, weight, capacity, weather) the potential purchaser must weigh the advantages and disadvantages of each remaining type and piece of equipment. It is highly recommended that field demonstrations be arranged to compare actual performance with stated performance. In addition, the potential purchaser may wish to talk with those in the profession using certain types of equipment to ascertain the strengths, weaknesses, and costs of each. Certainly more of this type of interchange should occur.

As pointed out previously, knowledge of the service area is absolutely essential to proper equipment selection. The type of customers, the type of refuse, the potential placement of containers, the ingress and egress dimensions are all significant factors that will affect vehicle performance.

ATTACHMENT I

ANALYTICAL TECHNIQUE FOR DETERMINING VEHICLE MANEUVERABILITY

Collection vehicle maneuverability is a function of vehicle size and turning capability, and the boundary constraints including narrow alleys and streets, encountered on the collection route. The vehicle characteristics which govern maneuverability are as follows:

- Wheel base
- Axle track
- Overall width
- Side overhang
- Front overhang
- Rear overhang
- Turning angle

These characteristics are diagrammed in Figure 1A.

Critical collection route boundary constraints (i.e., dimensions) must be known to determine whether a vehicle with the certain characteristics can maneuver within the boundary conditions.

The ensuing discussion provides methodology to aid in this determination.

Prior to developing a methodology for assessing maneuverability, the following assumptions were made:

- The critical boundary constraint is the intersection of two streets or alleys, the boundaries of which could not be encroached.
- The street or alley dimensions are known.
- The desired maneuverability is obtained when the

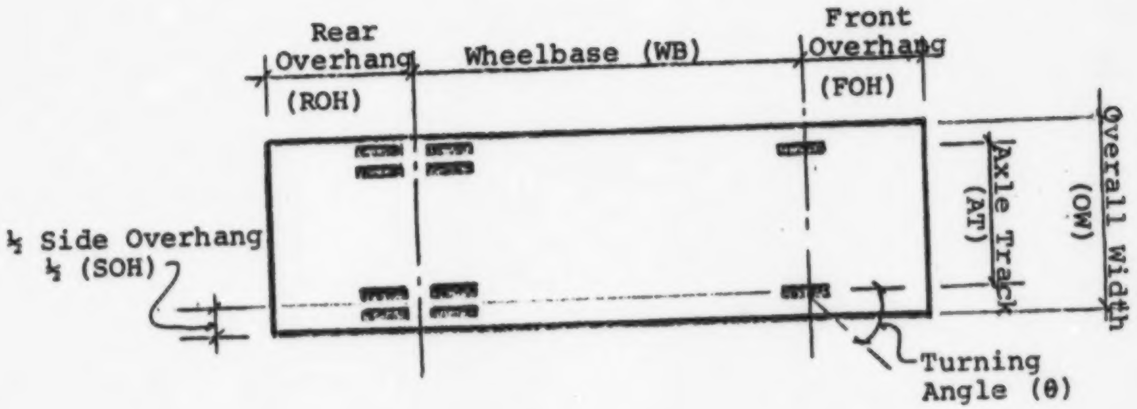

Rear
Overhang
(ROH)
Wheelbase (WB)
Front
Overhang
(FOH)
Overall Width
(OW)
Axle Track
(AT)
½ Side Overhang
½ (SOH)
Turning
Angle (θ)

Figure 1A

Vehicle Characteristics

vehicle can negotiate the turn in one continuous turning movement.

- The turning movement begins when the centerline of the front axle is parallel to and coincides with the curbline of the cross-street.
- The turning movement is circular rather than a spiral.

To negotiate a continuous turn under the assumed conditions, the vehicle must avoid contacting three critical points. These points are designated a, b, and c and are identified on Figure 2A. The suggested procedure to determine if a given vehicle will encroach on points a, b, or c is presented below.

- Location of the radii point

  The distance "d" is determined by the formula

$$d = \left[(ROH)^2 + (x + AT + 1/2\ SOH)^2\right]^{\frac{1}{2}} - ITB$$

where:

ROH = Rear overhang

AT = Axle track

SOH = Side overhang

ITB = Initial travel boundary (Figure 2A)

x = WB/Tan θ (turning $\angle$) (Figure 3A)

WB = Wheelbase (Figure 1A)

θ = Turning angle (Figure 1A)

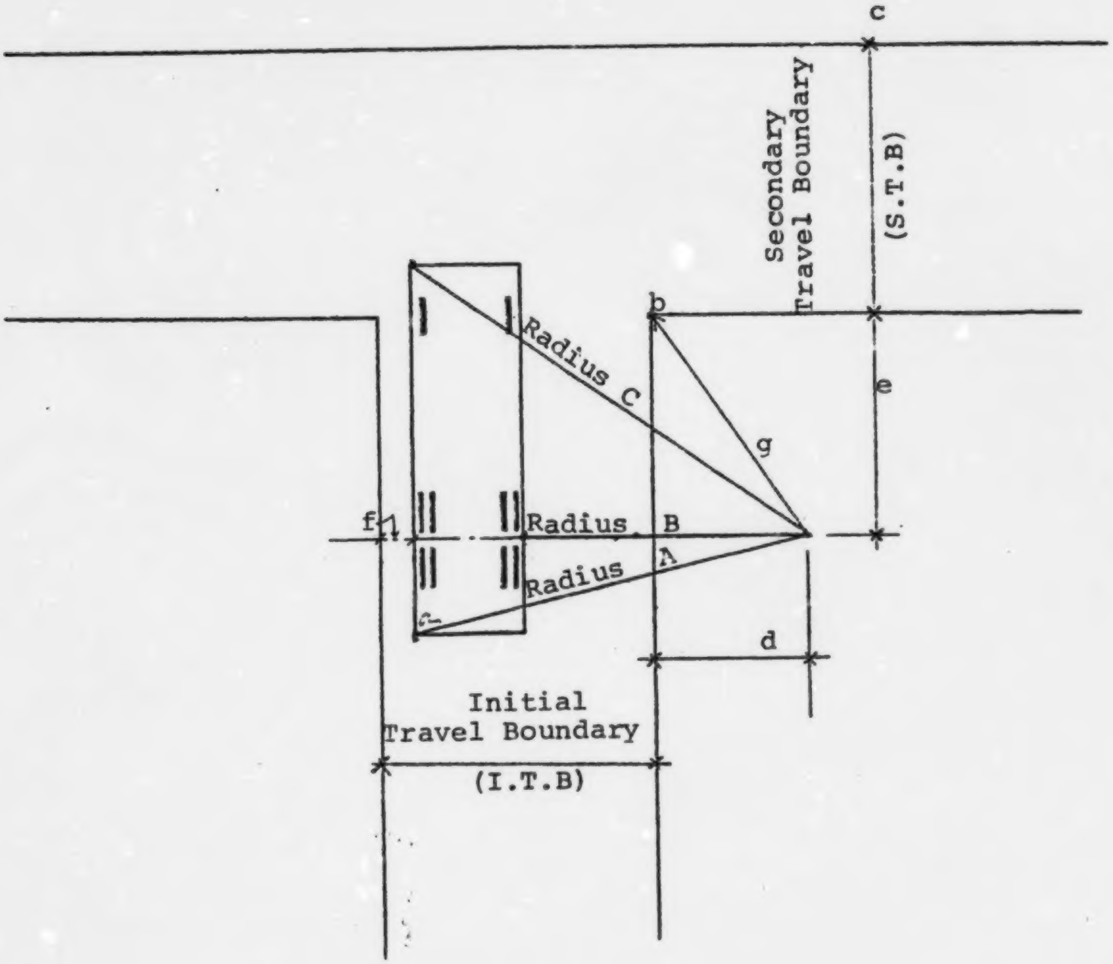

c
Secondary
Travel Boundary
(S.T.B)
b
Radius C
e
g
f
Radius B
Radius A
d
Initial
Travel Boundary
(I.T.B)

Figure 2A

Pertinent Maneuverability Characteristics

The distance "e" is equal to the length of the wheelbase

$$e = WB \text{ (Figure 2A)}$$

Determine radii lengths

Radius A indicates whether or not the rear of the vehicle will avoid point "a" and is determined by the formula:

$$\text{Radius A} = \left[(ROH)^2 + \left(\frac{WB}{\text{Tan } \theta} + AT + 1/2\ SOH\right)^2\right]^{\frac{1}{2}} \quad (2)$$

When initiating the turning movement the optimum distance that the vehicle should be from the outer boundary has been designated as the "f" distance as shown in Figure 2A. The "f" distance is equal to the Radius A $- \left(\frac{WB}{\text{Tan } \theta} + AT + 1/2\ SOH\right)$.

Radius B indicates whether or not the side of the vehicle adjacent the rear centerline of the wheelbase will avoid point "b" and is determined by the formula:

$$\text{Radius B} = \frac{WB}{\text{Tan } \theta} - 1/2\ SOH \quad (3)$$

The distance from the radii point to point "b" has been designated to be of length "g" and is equal to $(d^2 + e^2)^{\frac{1}{2}}$.

Radius C indicates whether or not the front of the vehicle will avoid point "c" and is determined by the formula:

$$\text{Radius C} = \left[\left(\frac{WB}{\text{Tan } \theta} + AT + 1/2\ SOH\right)^2 + (WB + FOH)^2\right]^{\frac{1}{2}} \quad (4)$$

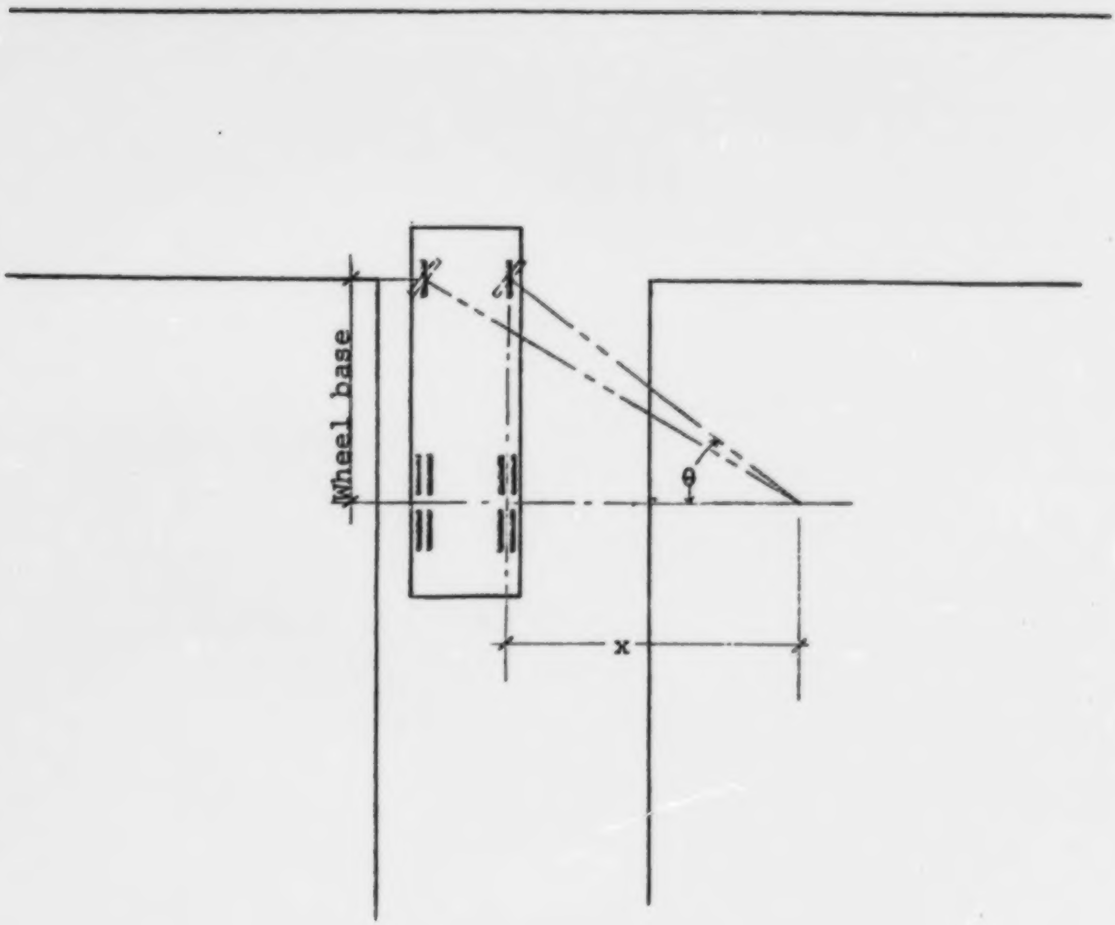

Wheel base
θ
x

Figure 3A

Derivation of "x"

The distance from the radii point to point "c" is equal to the wheebase plus the secondary travel boundary.

As can be noted, the formulas for determining radii distances a, b, and c are lengthy. Thus Graphs 1A, 2A, 3A, 4A, and 5A were developed as time saving aids for these determinations.

In order to develop usable graphs for all radii, two assumptions were necessary: (1) that an average axle track (AT) dimension is 77 in., and (2) that an average overall width (OW) dimension is 96 in. Therefore, the total side overhang (SOH) is 19 in. and one-half the SOH is 9.5 in.

- Graph 1A and Graph 2A - The graphic solution of the formula for Radius A.

  $$\text{Radius A} = \left[(\text{ROH})^2 + \left(\frac{\text{WB}}{\text{Tan } \Theta} + 86.5\right)^2\right]^{\frac{1}{2}}$$

  where:

  AT = 77"

  1/2 SOH = 9.5"

  The solution is broken into two parts:

  - Draw a straight line through the known values for WB and Θ on Graph 1A and extend the line until it crosses a point on the line designated as "t" which represents the solution to the quantity $\left(\frac{\text{WB}}{\text{Tan } \Theta} + 86.5\right)^2$.
  - Carry the value for "t" over to Graph 2A and draw a straight line through the known values for "t" and

ROH. The intersection of this line with the line designated Radius A is the graphic solution of the formula for Radius A in inches.

- Graph 1A, 3A, and 4A - The graphic solution of the formula for Radius C.

  $$\text{Radius C} = \left[(WB + FOH)^2 + \left(\frac{WB}{\text{Tan O}} + 86.5\right)^2\right]^{\frac{1}{2}}$$

  where:

  AT = 77"

  1/2 SOH = 9.5"

  The solution is broken into three parts:

  - Draw a straight line through the known values for WB and θ on Graph 1A and extend the line until it crosses a point on the line designated as "t" which represents the solution to the quantity $\left(\frac{WB}{\text{Tan } \theta} + 86.5\right)^2$.
  - On Graph 3A draw a straight line through the known values for WB and FOH and obtain the value "y" which represents the quantity $(WB + FOH)^2$.
  - Carry the values "t" and y over to Graph 4A and draw a straight line through these values. The intersection of this line with the line designated Radius C is the graphic solution of the formula for Radius C in inches.

- Graph 5 - The graphic solution of the formula for Radius B.

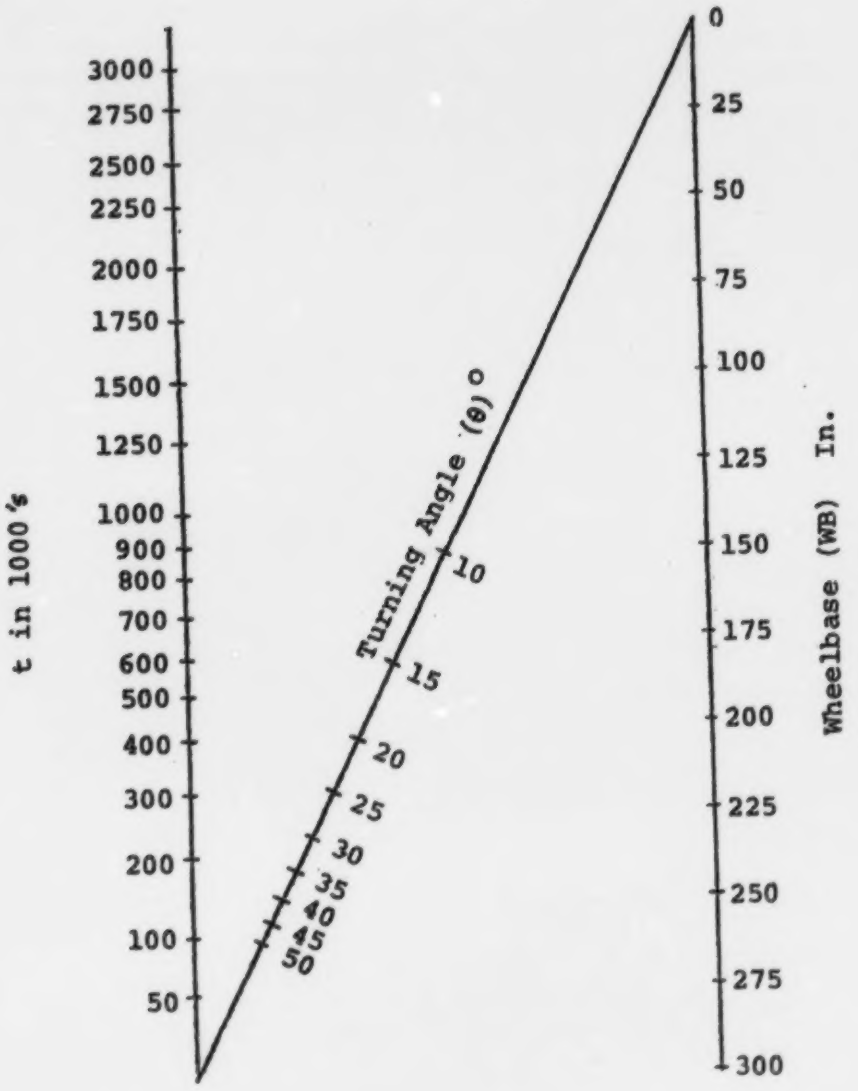
$$\text{Radius B} = \frac{\text{WB}}{\text{Tan } \theta} - 1/2 \text{ SOH} \quad \text{or}$$

$$\text{Radius B} = \frac{\text{WB}}{\text{Tan } \theta} - 9.5$$

where:

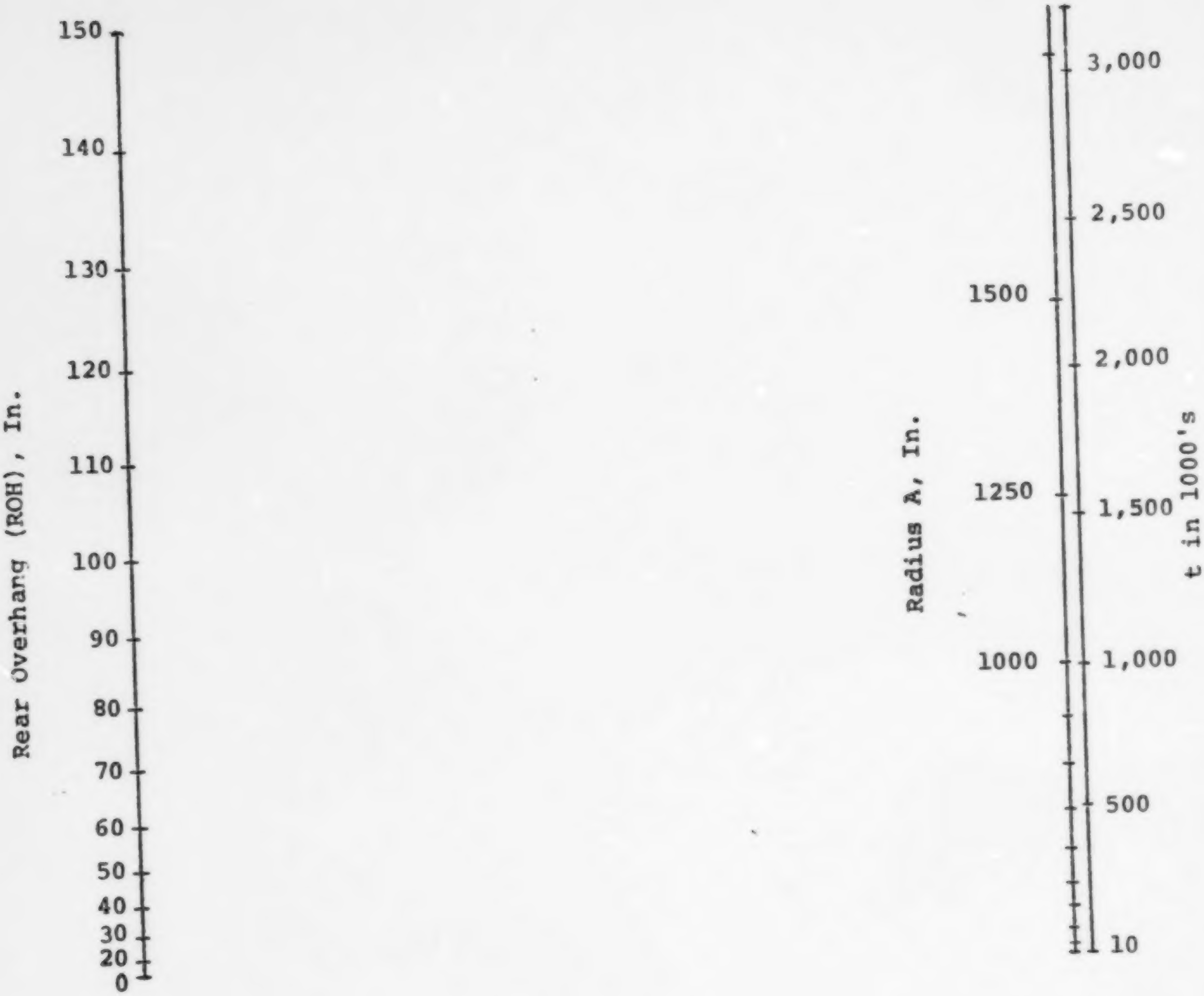
1/2 SOH = 9.5"

To determine Radius B, locate the known WB dimension along the abscissa and extend this point directly upward until it intersects the line representing the known value of θ. Then extend a line from this intersection parallel to the abscissa until it crosses the ordinate which represents Radius B in ft.



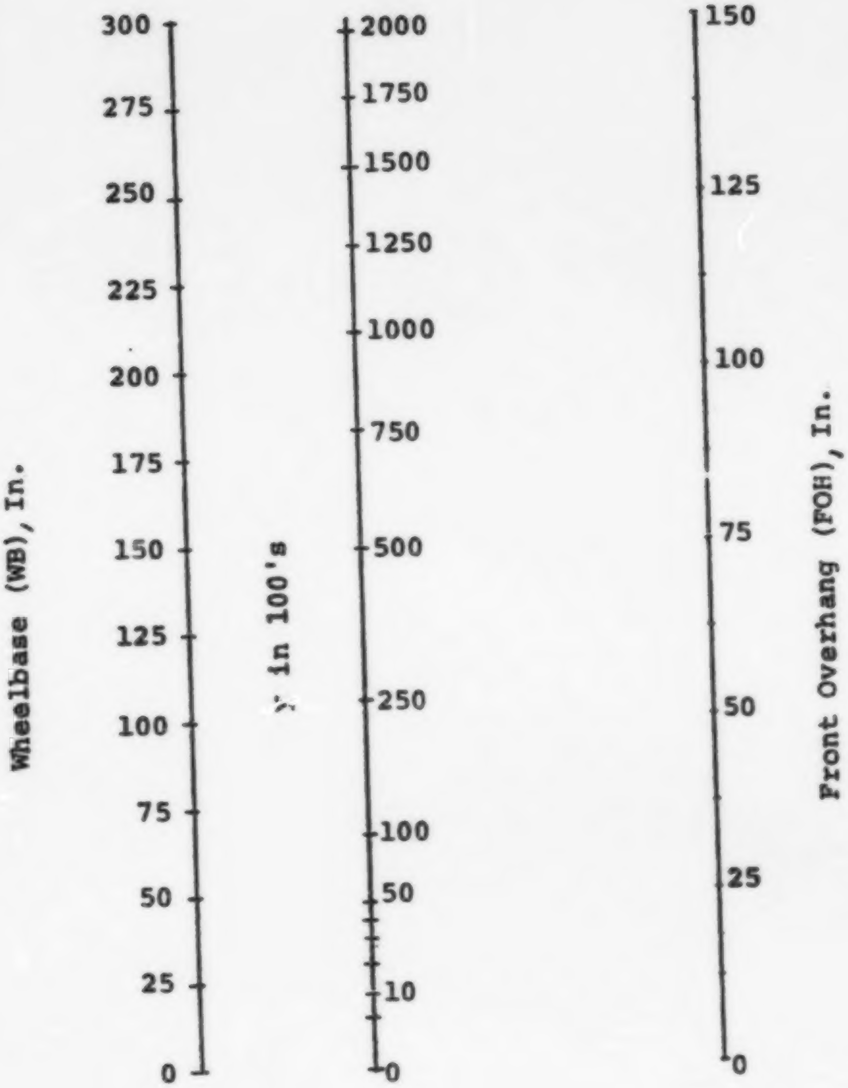
Graph 1A

$$t=\left(\frac{WB}{\tan\theta}+86.5\right)^2$$



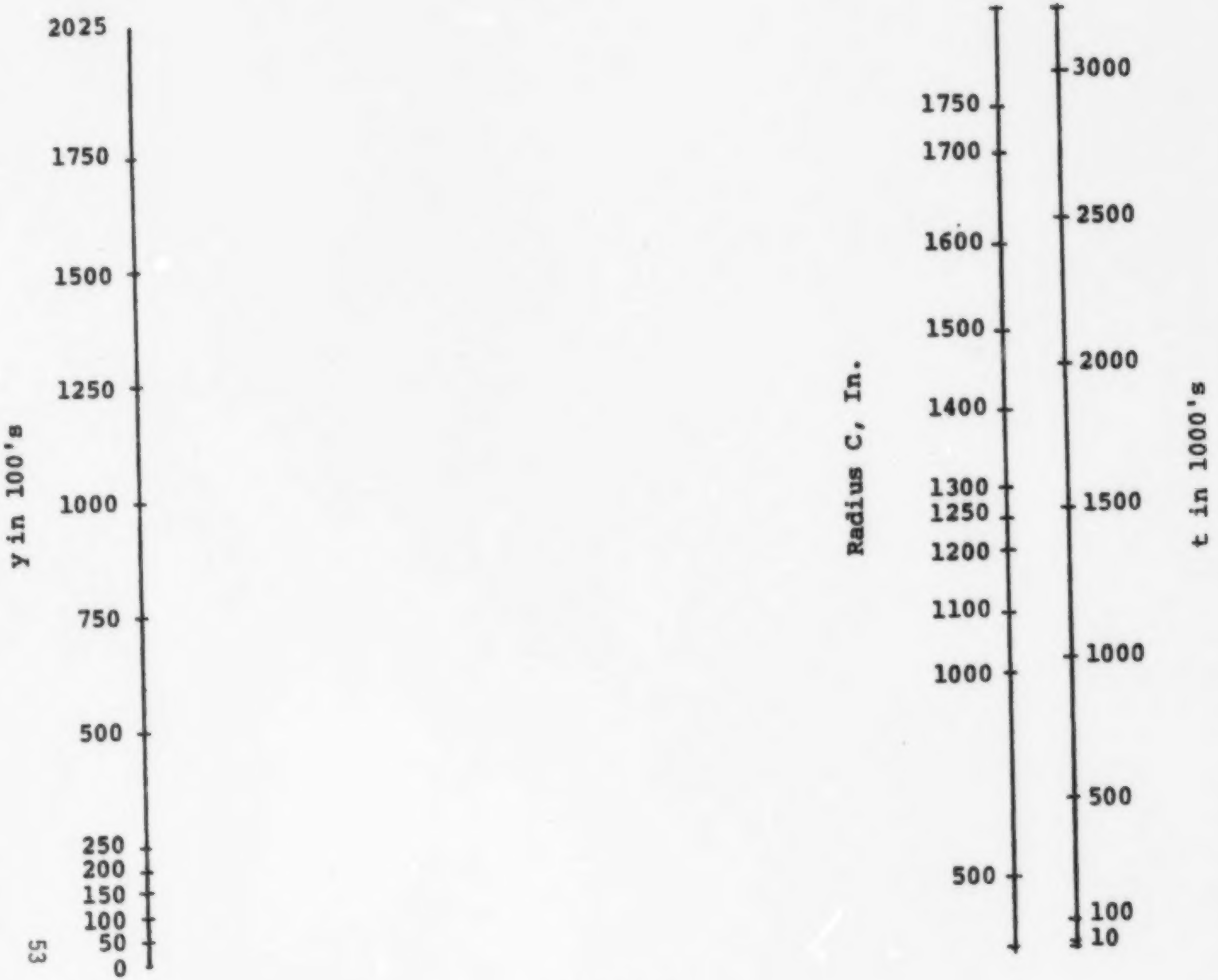
Graph 2A

Radius $A=(ROH^2+t)^{\frac{1}{2}}$



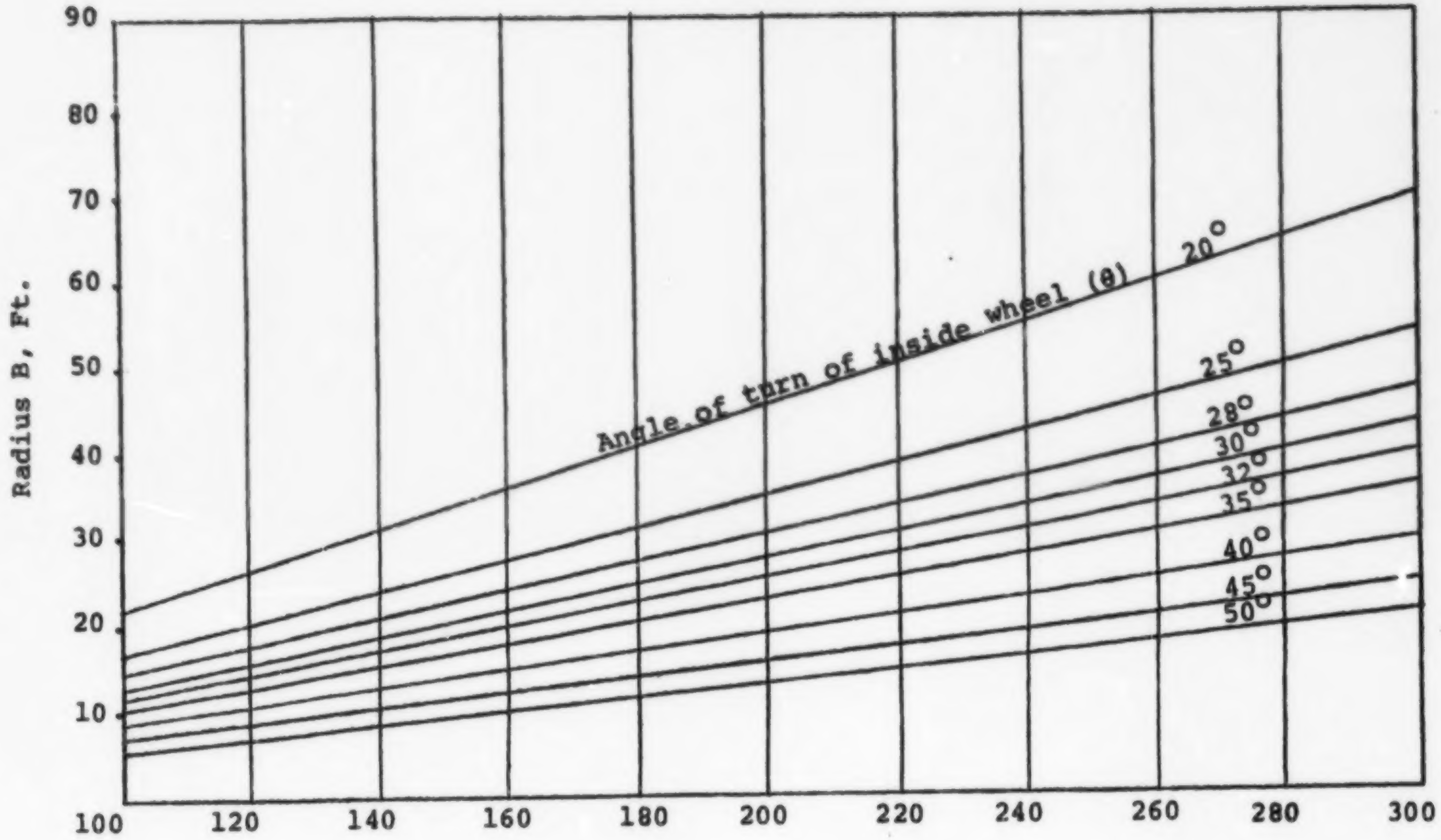
Graph 3A

$y = (WB+FOH)^2$



Graph 4A

Radius $C=(y+t)^{\frac{1}{2}}$



Wheelbase (WB), In.

Graph 5A

Determination of Radius B

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ATTACHMENT II

ANALYTICAL TECHNIQUE
FOR
DETERMINING VEHICLE
GRADEABILITY AND ACCELERATION

The vehicle engine performance characteristics are graphically depicted on the engine power curve which is based upon laboratory testing of the engine. However the performance of a given vehicle may be determined by the use of performance formulas. These formulas account for characteristics of the vehicle engine and transmission such as horsepower, gear ratios, and other variables. Other factors such as road grade and rolling resistance are also included in the formulas.

One characteristic used to rate engines is the horsepower (HP). The performance of the vehicle with a given engine will be affected by the gross vehicle weight (GVW).

For the formulas described in the following sections, certain assumptions were made for simplification. The following sections describe various formulas and charts used for determining performance characteristics of the vehicles. The assumptions made and precautions for using them are included.

Gradeability

One measure of vehicle performance is the sustainable speed on an up-hill grade. This is defined as the gradeability (G) of the vehicle. The formula for determining gradeability is as follows:

$$MPH = \frac{27,100}{(G + RR)} \times \frac{HP}{GVW} \qquad (1)$$

where

MPH = Maximum sustainable speed (miles per hour)

G = Grade of road (percent)

RR = Rolling resistance (percent)

GVW = Gross vehicle weight (lbs.)

HP = Engine brake horsepower. Rated horsepower less corrections for altitude or temperature. (Reduction in horsepower due to elevation in approximately 3 percent per 1000 ft of elevation above the rated elevation. Reduction for temperature is 1 percent for every 10^{o}F above the rated temperature.

A HP discount of 15 percent is commonly used for losses from operation of the fan, generator, water pump, magneto, distributor, fuel pump, and compressor. A further discount of 15 percent is applied to account for power losses in gear boxes and the rear axle. This discount also includes losses due to vehicle faulty steering geometry, and so forth.

The rolling resistance (RR) was assumed to be 1.5 percent. This value is commonly used for concrete and asphalt roads in good condition.

Results of the formula assume that the ideal gear ratio will be used to obtain maximum horsepower at maximum speed. However, rear axle or transmission gear ratios are often selected to maximize performance for operations other than climbing a grade. For example, when collection vehicles must travel on freeways to a disposal site, the gear ratios may be selected to enable the vehicle to develop a sufficient cruising speed. Therefore the above formula will provide the limiting condition only (the maximum speed when ideal gear ratios are present). The actual speed developed may be somewhat less than predicted by the formula.

Figure 1B shows a family of curves prepared using the gradeability formula.

To use the curves, enter along the Y-axis with the GVW/HP determined for the vehicle under consideration. Proceed horizontally to the right until the curve for the desired grade is reached. Then proceed straight down and read the maximum sustainable speed on the x-axis.

A more accurate estimate of the gradeability can be obtained through the use of other formulas. The vehicle gradeability can be calculated assuming operation in certain gears. Comparison of gradeability calculations for various gears can determine the best gear to use to maximize gradeability. The formulas which can be used are:

$$G = \frac{(1200)\ T\ (e)\ (E)\ (R)}{r\ (GVW)} - RR \qquad (2)$$

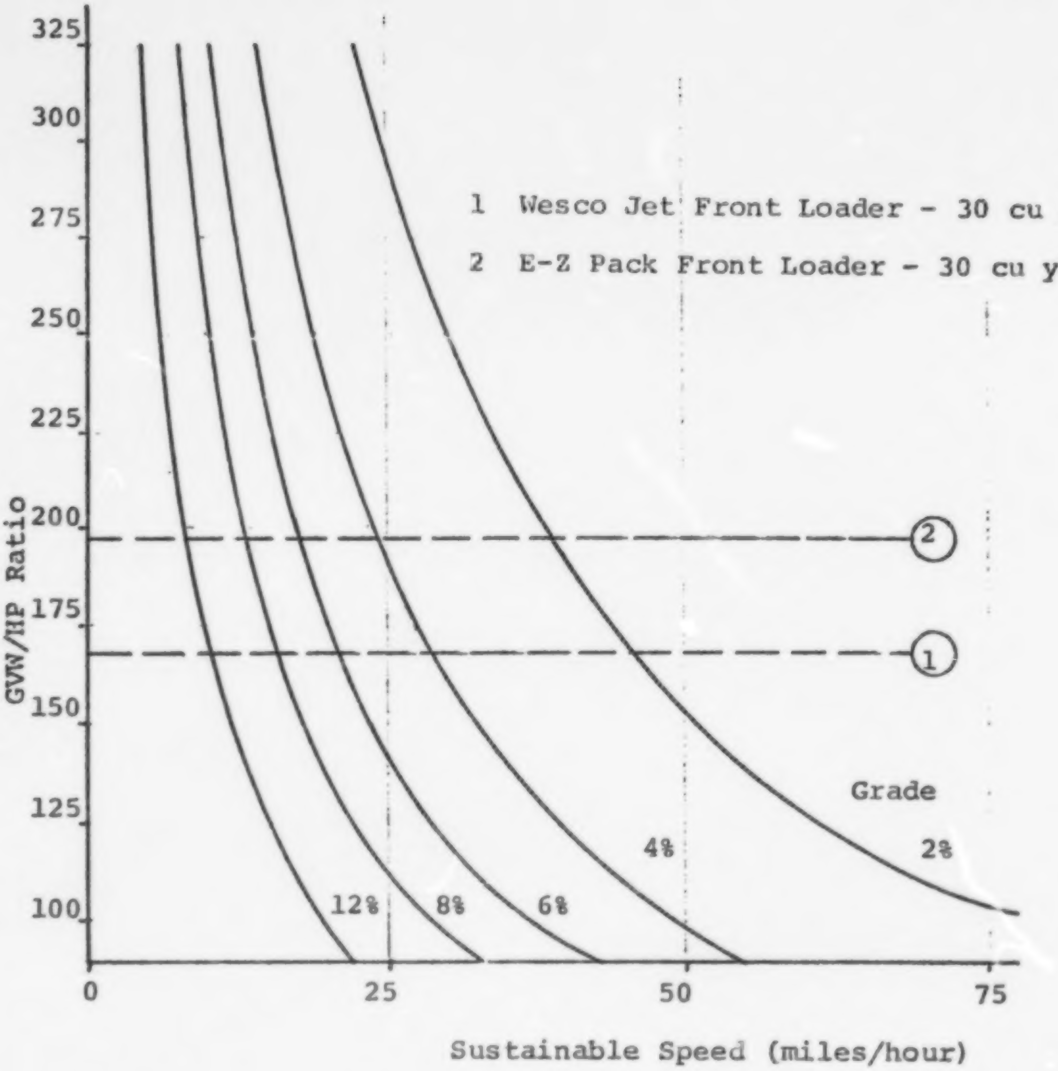

Figure 1B

Gradeability of Collection Vehicle

and

$$MPH = \frac{RPM\ (r)}{168\ (R)} \qquad (3)$$

where

G = Grade of road (percent)

T = Maximum engine torque (pound-feet)

e = Mechanical efficiency from engine to tires, expressed as a decimal. If actual value is unknown, use 0.85.

E = Efficiency of gears, expressed as a decimal. If specific data is not available use 0.85.

R = Overall gear reduction including both transmission and rear axle. Calculate by multiplying the rear axle gear ratio times the transmission gear ratio for the gear under consideration.

GVW = Gross vehicle weight (lbs.)

RR = Rolling resistance (percent)

MPH = Maximum sustainable speed (miles per hour)

RPM = Engine revolutions per minute at maximum torque, obtained from the engine curve.

r = Rolling radius of tires (inches)

Formula (2) is used with various combinations of overall gear ratios to calculate the grade which can be climbed when engine rpm is maintained at the maximum torque. Formula (3) can then be used with the rpm and gear ratios to calculate speed on the grade.

Acceleration

The ability of a collection vehicle to accelerate will affect the time required to complete the refuse collection route. Collection vehicles accelerate between many stops along the route.

Formulas for acceleration are based on Newton's law of motion for a mass. The formulas account for various parameters such as rolling resistance, torque, gear ratios, rolling radius of tire, and the weight of the vehicle. The formula for determining acceleration is as follows:

$$a = \frac{1,466,000\ (HP)(R)}{(GVW)(r)(RPM)} - RR\ (0.322)$$

where

a = Acceleration (miles per hour per second)

GVW = Gross vehicle weight (lbs.)

HP = Engine brake horsepower. Rated horsepower less corrections for altitude or temperature.

r = Rolling radius of tires (inches)

RPM = Engine revolutions per minute (When determining acceleration from a standstill, use 75 percent of the engine RPM at governed speed).

R = Overall gear reduction including both transmission and rear axle. Calculate by multiplying the rear axle gear ratio times the transmission gear ratio for first gear. For vehicles equipped with torque converters the average of gear ratios available for first gear can be used.

RR = Rolling resistance (percent)

The formula accounts for power losses of accessories (discount of 15 percent) and losses which occur in driving through the various gears (discount of 15 percent). Formula (4) may be used to determine the acceleration that a given vehicle can obtain under given conditions.

To determine acceleration of a moving vehicle, the gear in use as well as the engine horsepower and RPM must be known. The horsepower and RPM can be taken from the engine performance curve.

After determining the acceleration, the time required to accelerate from one speed to another speed may be determined by the following formula:

$$t = \frac{(V-V_o)\ 1.47}{a} \qquad (5)$$

where

t = Time to accelerate (seconds)
V = Final speed (miles per hour)
Vo = Original speed (miles per hour)
a = Acceleration in miles per hour per second

A special case of acceleration is the acceleration of a vehicle from rest. The rated horsepower of the engine and the transmission gear ratio for first gear are used in Formula (4). For RPM, use 75 percent of the governed RPM as determined from the engine curve.

A family of curves derived from Formula (4) are depicted on Figure 2B. To facilitate in the preparation of the curves, several assumptions were made based on normal conditions found for collection vehicles operating on routine routes. The assumptions are as follows:

- r = 20 inches (collection vehicles typically have tires with a rolling radius of about 20")
- RR = 1.5 percent (this is the average rolling resistance of rubber tires on concrete and asphalt roads in good repair)

The curves can be used to determine acceleration for a vehicle when (GVW/HP) and (RPM/gear reduction) are known. The curves can be used for vehicles accelerating from rest and vehicles changing speed. Each curve represents a different RPM/gear reduction ratio.

To use the curves enter the figure on the ordinate with a known GVW/HP ratio and proceed to the right parallel to the abscissa until the constructed line intersects the appropriate RPM/gear reduction curve. Continue downward parallel to the Y-axis. This line will intersect the X-axis at the

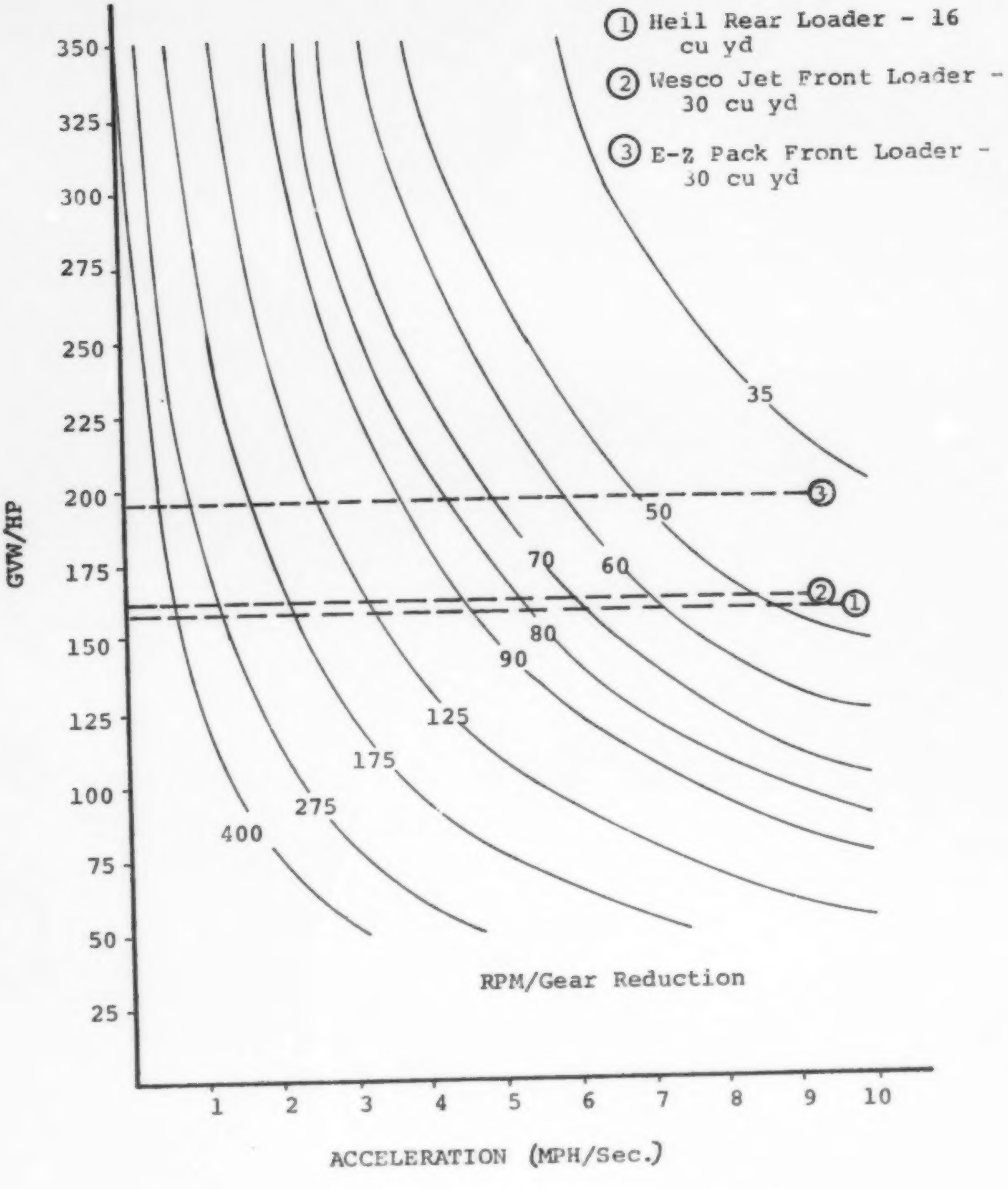

Figure 2B. Acceleration of Collection Vehicle

acceleration of the vehicle under consideration.

For the special case of a vehicle accelerating from rest, Table 1B is used to determine the time required to accelerate from rest and travel a given distance. After the acceleration is determined by Formula (4) or Figure 2B, the time to accelerate from rest and travel a certain distance can be determined from Table 1B. The times included in the tables are for travel time during acceleration only and do not include the time to stop after acceleration.

TABLE 1B

TIME TO ACCELERATE AND TRAVEL A GIVEN DISTANCE

Accel. (MPH/Sec)	Distance (Ft.)/Time (Sec)					
	25	50	75	100	125	150
1	6	8	10	12	13	14
2	4	6	7	8	9	10
3	3	5	6	7	8	8
4	3	4	5	6	6	7
5	3	4	4	5	6	6
6	2	3	4	5	5	6
7	2	3	4	4	5	5
8	2	3	4	4	5	5

ATTACHMENT III

SCOTTSDALE TRANSFER SYSTEM

ATTACHMENT III

SCOTTSDALE TRANSFER SYSTEM

With a haul time of 40 minutes or longer, a collection truck may spend one-half of the work day hauling. Eliminating or significantly reducing haul time significantly increases service time. Scottsdale is a long, narrow city with its landfill locating east of the southern part of the city. Thus, haul times for the northern portion of the city is significant.

The City of Scottsdale uses a large transfer trailer for both residential and commercial collection vehicles. It has an 80 cubic yard capacity, and can accommodate up to three full loads. The commercial collection vehicles are modified to work with the trailers that require special tailgates and ejection systems. The system operates in the following manner: The collection vehicle backs up to the trailer, tailgate to tailgate, and a guide aligns the two units so they mate properly. A hydraulic mechanism fastens the two units together. Both tailgates are built like segmented garage doors and may be raised by pulling them over the upper rear corner and along the top of the body. With the rear ends interlocked raising the collection vehicle tailgate raises both. With the tailgates raised, the material is ejected into the rear of the trailer. With the load transferred, the ejection plate stops at the rear of the truck in a position where its sloped working face can be cleared off by the tailgates as they are lowered back into place. The entire operation should not take the collection vehicle away from the route for more than ten minutes. Thus the trailers can be operated by the collection vehicle driver who must leave the cab only to make the electrical and hydraulic connections.

The trailer can be left set up and unmanned, as it needs no power. Set-ups are made in temporary convenient lots such as parks, church parking lots, streets adjacent to vacant lots, vacant lots, and other locations.

The portable station pays off when haul times exceed 30 minutes.

APPENDIX IV

PERFORMANCE MEASUREMENT FOR COMMERCIAL REFUSE COLLECTION

APPENDIX IV

PERFORMANCE MEASUREMENT FOR COMMERCIAL REFUSE COLLECTION

As part of the user charge study, it was determined that a necessary prerequisite to performance measurement and its cost implications was a further delineation of the activities performed by refuse collection vehicles. Specifically, it was felt that time-motion and other measurement techniques could be applied to commercial refuse collection. The output of such a study could be used for the following purposes:

(1) A management tool reporting performance for the individual operator, equipment, route and department.

(2) A management tool reporting a truer cost picture for a single customer, a route and department. From this data conscious decisions could be made on possible user charge rate.

(3) An aid in vehicle selection or design where the impact of vehicle variables such as body size, lift speed, compaction time and maneuverability could be evaluated in the computer model by comparing the trade-offs of a proposed vehicle with an existing vehicle on a specific route.

(4) A customer counseling tool where the effects of container size, frequency of collection, container location, etc. could be shown in dollars and cents

thereby providing alternatives for the most efficient combination of factors.

(5) A means of determining manpower and equipment utilization and capability as applied to the total route complex for justification of additional shifts, manpower and equipment.

(6) Criteria for accepting or rejecting a customer, and setting a rate for special customer characteristics.

(7) A way of determining the route size for given pieces of equipment.

The above returns represent some of the more immediate applications of performance measurement. Computer modeling, route simulation, and other operations are possible.

Purpose

The purpose of the study was to determine the feasibility of applying measurement techniques to the interaction of man, machine, and customer characteristics that occurs in the operation of a commercial refuse collection route.

The study was aimed primarily toward work measurement for a commercial refuse collection route, consequently the times allowed for vehicle standards for lifting, compacting and maneuvering are specific to Scottsdale equipment and are weighted somewhat by operator difference and topographical conditions and may not apply literally to other jurisdictions for vehicle selection.

The variables identified in this study represent a set of measurable values that could be used and applied to any commercial refuse collection system. That is, the formulas contained herein represent valid relationships between different time elements. However, the empirical values derived are valid for Scottsdale only, and should not be applied generally without measuring or carefully projecting their values.

Methodology

In making the evaluation, it was necessary initially to ascertain the various elements of the work content that collectively comprise 100% of the function. The second step was to break down each element into measurable segments of time, distance, speed and volume and determine which was constant, variable or semi-variable. The third stage was to develop formulas for each element that are both an accurate and equitable mathematical expression of each function. The fourth step was to collect field data on route area, vehicle performance and size, topographical conditions, speeds, distances, refuse classifications, and operator variables. Finally, the raw data had to be evaluated, condensed to meaningful values and presented in tabulated or other easily understandable form. As a final step, differences between Scottsdale and Mesa were measured and analyzed to show comparative data and check for reasonableness.

Productivity Considerations

During the course of the study, it became apparent that maximum productivity could be achieved by combining optimum vehicle capability, operator methods, route design and container placement. The best practical approach is to provide a combination of as many favorable factors as possible within the constraints imposed by available equipment, container and route conditions. Comments and suggestions by the operators together with observations made during the study were evaluated and compiled into a concise outline for optimum conditions as follows:

(1) Vehicle

- Maximum body size with minimum weight to allow largest legal payload.
- Comfortable cab with controls located as close and convenient to the operator as practical.
- Fast lift arms that operate safely, smoothly, and freely while truck is in motion.
- Good maneuverability with short turning radius, adequate power, acceleration and braking.
- Automatic, low profile closing and opening of top door to minimize litter when the vehicle is in motion.
- Cab-mounted warning light that indicates when vehicle has reached maximum weight, for safety purposes as well as productivity consideration.
- Periscope mirror in top of cab for viewing container and top door during dump cycle.

- Remote controlled opening and closing of rear door with hydraulic cylinder or roll up apparatus.
- Design of compactor plate and body that prevents debris from falling in front of the plate.
- Interlocks to prevent dumping if packer plate is not completely forward or top door is closed.

(2) Operator

- Maintain maximum safe speed at all times.
- Load vehicle to maximum allowable weight.
- Perform simultaneous operations such as compacting while traveling between containers; close top door while backing away from container; position lift arms while approaching container.
- Minimize compacting, positioning lift arms, and opening or closing top door while vehicle is standing still.
- Dump container only when packer plate is completely forward.
- Take most direct route to containers that allows fastest access and egress and least maneuvering.
- When loaded, take most direct route to a rural artery consistent with traffic and congestion conditions.
- Operate equipment carefully and properly to minimize down time due to breakdowns.
- Report vehicle malfunctions promptly and accurately to promote concept of preventive maintenance.

- Take allowed rest periods and lunch break to minimize fatigue.
- Continually evaluate customer usage of containers and make recommendations to supervisor for customer counseling to increase the size and decrease the number of containers and frequency of pickups, while meeting customer's collection needs.
- Conscientiously report containers needing repair.
- Review route book daily to make certain each customer has been serviced.

(3) Route Design

- Minimum overlapping of area covered by routes.
- Layout route to have maximum customer density.
- Arrange customers in sequence to maximize the number of right turns into and out of customer property.
- Arrange customers in sequence to allow early pickup where traffic and congestion becomes a factor later in the day.
- Minimize the necessity for left turns or completely crossing streets with vehicle.
- Assign more maneuverable vehicles to routes having greater difficulty of access and egress.
- Tailor the route size to be consistent with the capability of the vehicle.
- Discourage the use of roll out containers, locked containers and gates enclosing containers.

- Solicit container usage information from drivers and use it for customer counseling. The object should be to provide the minimum cost for an acceptable level of service.

(4) Container

- Proper placement of the container is the most significant factor in efficiently servicing a customer. Container placement as shown in Figure 6 and described as Type 1 egress should be utilized whenever possible.
- If Category 1 egress is not possible, container should be located such that minimum backing up and maneuvering is required.
- Locate container on public access where possible.
- Avoid locating containers beneath utility wires where possible.
- Locate multiple containers at single address within close proximity of each other, if possible, unless greater spacing would be beneficial to compacting while traveling to next container.
- Maintain level, smooth area at approach to and at container location.
- Design containers with sliding side doors or no side doors at all.
- Stencil "NO PARKING" on containers on side nearest to the collection vehicle.
- Stencil "KEEP CLOSED" or other appropriate wording on side doors. Refuse to dump containers of those who

perpetually leave side doors open.

- Encourage larger container size at single address rather than multiple smaller containers.
- Avoid use of containers that the door (or doors) does not completely cover the top.
- Place containers in such a manner that they are on the same plane as the vehicle lift arms.

Elements of Commercial Collection Work

From numerous field operations it was concluded that there are four basic elements of work content basic to all commercial refuse collection customers. When computed and assigned to each individual customer, they represent the true direct and pro-rata time for servicing that customer. Further, by summing these elements for every customer on a particular route, the standard time allowed for that route, when serviced by a specific vehicle, may be calculated.

The four elements of work content are:

(1) Miscellaneous and Crew Time Allocated to Each Customer:
This element allocates non-productive time to each customer by multiplying each customer's percentage of the three "direct" elements of total route time by the non-productive time. One-half the distance from the corporation yard to the first customer on the route is pro-rated in the element; the other one-half is charged to the first distance as a portion of the first customer's travel time.

(2) Travel Time Between Customers:
This element is the time traveled on public access between customers. The average speed attained is relative to the

distance traveled. (Figure 2). The allocation is made on the premise that each customer is charged for one half the distance from the prior customer and one half the distance to the next customer. The first customer on the route is charged one half the distance from the corporation yard with the other one half being allocated over the entire route in the Miscellaneous and Crew Time Element.

(3) Service Time for Container:

This element includes the productive time of traveling on the customer's premises both to and from the container, maneuvering into position, lifting, dumping and replacing the container, opening gates and rolling out containers. Pro-rated into the service time is a percentage of the compaction time for the vehicle based on the frequency of compaction, the volume of the container and the compaction ratio associated with the refuse type.

(4) Haul Time Assigned to Each Customer:

This element allocates the time required to travel to the landfill, unload and return to the route. The allocation is based on the volume of the truck used by the customer, taking into consideration the total container volume and the compaction ratio of the refuse type.

Each of these four elements can be determined empirically using formulae that detail each of these elements and express them in mathematical relationships.

The following section presents the formulae and then describes the terms used:

(1) T_{pr} = Miscellaneous and Crew Time Allocated to Each Customer

(a) Formula

$$T_{pr} = \left(C_m + 1/2\,\frac{dp}{V_s}\right)\frac{T_{sa} + T_{ha} + T_{tb}}{T_{shta}}$$

(b) Terms

C_m = Constant miscellaneous time

d_p = Distance from corporation yard to first customer

V_s = Average vehicle speed

T_{sa} = Service time for each customer

T_{ha} = Haul time assigned each customer

T_{tb} = Travel time between each customer

T_{shta} = Total travel, service and haul time for complete route

(2) T_{tb} = Travel Time Between Customers

(a) Formula

$$T_{tb} = 1/2\left(\frac{dp}{V_s} + \frac{dn}{V_s}\right)$$

(b) Terms

d_p = Distance from corporation yard to first customer or distance between prior customer and this customer

d_n = Distance between this customer and next customer

V_s = Average vehicle speed

(3) T_{sa} = Service Time for Container

Note: The other three elements relate directly to the customer. However, this element relates to each container and the equation must be repeated for each container located on the customer's premises to obtain total service time for the customer.

(a) Formula

$$T_{sa} = \frac{d_a}{V_s} + L_n + E_t + \left(F_c\ C_t\ R_c\ V_c\right) + G_t + R_t$$

(b) Terms

d_a = Distance on access route

V_s = Average vehicle speed on access route

L_n = Lifting time

E_t = Egress time

F_c = Frequency of compaction

C_t = Compaction time

R_c = Reciprocal of the compaction ratio of refuse type

V_c = Service volume of container

G_t = Time for opening gate or unlocking container

R_t = Time to roll out container

(4) T_{ha} = Haul Time Assigned to Each Container

(a) Formula

$$T_{ha} = \frac{R_c\ V_{sa}}{V_t} \left(\frac{d_u}{V_s} + \frac{d_r}{V_s} + T_u\right)$$

(b) Terms

R_c = Reciprocal of the compaction ratio of refuse type

V_{sa} = Service volume available to customer

V_t = Usable volume of truck

d_u = Urban distance traveled to landfill

d_r = Rural distance traveled to landfill

V_s = Average vehicle speed

T_u = Time to unload at landfill

Discussion of Terms

(1) Similar Terms Used in Several Equations

(a) Distance (d_p, d_n, d_a, d_u, d_r)

Distance is measured in feet and converted into decimal miles for use in the formula as follows:

$$\frac{\text{distance in feet}}{5280} = d_p, d_n, d_a, d_u, \text{ or } d_r$$

Tabulation may be made periodically reflecting some of the relatively constant distances as shown in Figure 1.

* d_p = distance from corporation yard to first customer or distance between prior customer and this customer

This is the distance traveled by the collection vehicle on public streets and alleys. The distance begins at the point the vehicle turns onto public access from the customer and ends where it turns off public access onto private property for the next customer. (Figure 1). This distance is determined easily from a scale map.

* d_n = distance between this customer and next customer

The same description applies as for d_p, and is determined by empirical observation using a mileage indicator.

* d_a = distance on access route

This distance is measured from the point where the vehicle leaves the public street, alley or road. It includes all distance traveled on private property except for the final 20-50 feet of approach to the container which is included in the lifting time. If the container is within 50 feet (direct access) of the public access the distance is ignored and the d_a is zero. The distance from the container back to the access point must be added to the distance from the access point to the container to determine total access distance. Where multiple containers are scattered on the premises of a single address the d_a must be determined for each if they are greater than 50 feet apart. The distance back to the access point is added to the approach distance of the final container. d_a should be measured fairly accurately with a small vehicle that simulates the path taken by the refuse collection vehicle, or by carefully scaling an aerial photo or large scale map.

* d_u = urban distance traveled to landfill

This is the distance traveled in urban areas to and from the landfill. It is measured from the approximate geographical center of each route to the beginning of a rural area. The d_u is twice the one way urban distance. Urban thoroughfares are defined as having a speed limit of 45 mph or less. (Figure 1). d_u is determined easily from a scale map, or using odometer readings.

* d_r = rural distance traveled to landfill

Rural distance traveled to and from the landfill is measured from the appropriate rural intersection as reached by traveling an optimum route from the approximate geographical center of each route. The d_r is twice the one way rural distance. Rural thoroughfares are defined as having a speed limit in excess of 45 mph (Figure 1). d_r is measured easily with an odometer.

CITY OF SCOTTSDALE

Route Number	Begins At	Distance (Ft.)	d_p (mi.)	From: Urban Inter-section	To: Rural Inter-section	One Way Urban Distance	d_u (mi.)	One Way Rural Distance	d_r (Mi.)
07 M-TH	Jack in the Box 7412 McDowell	6,550'	1.240	Bellview & 69th	Pima & McDowell	13,805' 2.615 mi	5.23	3.5 mi	7.0
08 T-F	Scotts. Mobile 7660 McKellips	650'	.123	Roosevelt & Hayden	Pima & McDowell	7,920' 1.500 mi	3.00	3.5 mi	7.0
11 M-Th	Salt Cellar 550 Hayden	3,950'	.748	Thos. & 65th	Pima & Thomas	14,755' 2.795 mi	5.59	4.5 mi	9.0
12 T-F	Amer. Serv. Sta. 8138 Ind. Sch.	19,210'	3.638	Granite Reef & McDonald	Pima & McDonald	2,640' 500 mi	1.00	7.5 mi	15.0
15 M-Th	Shield Electric 3134 Scottsdale	13,750'	2.604	76th & McDonald	Pima & McDonald	7,920' 1.500 mi	3.00	7.5 mi	15.0
16 T-F	Beckman 350 Hayden	2,250'	.426	4th Avenue & Miller	Pima & Indian School	9,000' 1.705 mi	3.41	5.5 mi	11.0
19 M-Th	Yavapai School 701 Miller	2,000'	.378	Pinto Lane 3rd Street	Pima & Thomas	17,405' 3.297 mi	7.59	4.5 mi	9.0
20 T-F	Yavapai School 701 Miller	2,000'	.378	Earll Dr. & Miller	Pima & Thomas	9,055' 1.715 mi	3.43	4.5 mi	9.0
23 M-Th	PV Guest Ranch 5001 Scottsdale	24,000'	4.545	74th & Cholla	Hayden & Shea	9,200' 1.743 mi	3.49	12.5 mi	25.0
24 T-F	5th Ave Gallery 4234 Craftsman	20,600'	3.901	Minnezona & Miller	Pima & Indian School	11,100' 2.103 mi	4.21	5.5 mi	11.0
27 M-Th	Burger King 7444 McDowell	6,750'	1.278	3rd Ave &70th	Pima & Indian School	12,380' 2.345 mi	4.69	5.5 mi	11.0
28 T-F	Medical Center 1402 Miller	4,900'	.928	McDowell & Miller	Pima & McDowell	7,880' 1.493 mi	2.99	3.5 mi	7.0
37 W	Yavapai School 701 Miller	2,000'	.378	Minnezona & Miller	Pima & Indian School	11,100' 2.103 mi	4.21	5.5 mi	11.0

FIGURE IV - 1. DISTANCE TO BEGINNING OF ROUTE, CITY OF SCOTTSDALE

(b) Vehicle Speed (V_s)

Average vehicle speed is relative to the vehicle capability (eg gross vehicle weight, gear ratios, horsepower, number of axles, wheelbase, turning radius, etc.), the distance traveled and the terrain conditions on the vehicle route. All of these factors should be considered when this data is developed for each community. The City of Scottsdale has very few hills or grades, the streets are laid out on a grid system with major arterials allowing maximum speeds, public-rights-of-ways (alleys) are established to maximize continuity, and signalization of roads is based on demand. In short, Scottsdale's conditions are such that most variations in equipment capability are minimized. It has been sufficient for this study to use the same speeds for all equipment. Other analysts may prefer to make speed determination for several classes of equipment or for different street conditions.

The method used to determine average urban vehicle speed for Scottsdale was to time vehicles for various distances and convert to miles per hour.

Note: Even though the data was collected on two dissimilar vehicles, a pattern appeared from which the values in Figure 2 were assigned. This element could be expanded over more observations and a greater variety of vehicles to enhance reliability of values assigned. Average rural vehicle speed was determined by timing both loaded and empty vehicles over rural thoroughfares during varying traffic conditions. All vehicles were included in the study. The result is the simple average of all vehicles. (Figure 2). The V_s value in miles per minute was determined by dividing the MPH by 60.

CATEGORY	DISTANCE	MILES/HR.	V_s
Urban	Up to 100'	4	.067
Urban	100' to 500'	6	.100
Urban	500' to 2500'	12	.200
Urban	Over 2500'	18	.300
Rural	Over 2500'	33	.550

FIGURE IV-2

AVERAGE URBAN & RURAL VEHICLE

SPEED FOR VARIOUS DISTANCES

(c) Reciprocal of the Compaction Ratio of Refuse Type (R_c)

Data for determining the values in this term was gathered in an earlier study included under the grant umbrella of which this dissertation is a part. Using the "Commercial Classification" system as a basis, data was collected and a curve drawn to reflect compaction ratios. For use in the formula the reciprocal had to be calculated and is shown in Figure 3. Additional research in this area should be made before these values are taken literally.

REFUSE TYPE	COMMERCIAL CLASSIFICATION	COMPACTION RATIO	R_c
1	Residential	5.0:1	.200
2	Commercial	6.5:1	.154
3	Service Station	4.5:1	.223
4	Hospitals	6.0:1	.167
5	Restaurants	5.5:1	.182
6	Light Industry	2.4:1	.417
7	Heavy Industry	1.8:1	.556
8	Agriculture	3.0:1	.33
9	Compacted Material	0.8:1	1.250

FIGURE IV-3. RECIPROCAL OF THE COMPACTION RATIO OF REFUSE TYPE

(2) Miscellaneous and Crew Time Allocated to Each Customer (T_{pr})

(a) C_m = Constant Miscellaneous Time

91 minutes is the value assigned to this term for all routes. It consists of two fifteen-minute breaks, seven minutes check-in time at end of shift, thirty minutes personal time and twenty-four minutes for unavoidable delay caused by parked cars, necessary conversations, spilled garbage, equipment malfunction, etc. Note: (This allowance may be inadequate and should be adjusted to meet conditions of the community. No factor is included for operator fatigue since the operations are machine paced to a larger degree.)

(b) Total Travel, Service and Haul Time for Complete Route. (T_{shta})

Since the miscellaneous and crew time is allocated to each customer based onthe total amount of service received, it is imperative that the total route time for service, travel, and haul be determined so a proration on a percentage basis may be made to each customer.

(3) Travel Time Between Customers

All terms were described previously in III (1).

(4) Service Time for Containers

(a) Lifting Time (L_n)

Lifting time begins when the operator lifts his foot from the vehicle accelerator approximately 20-50 feet from the container. It includes the necessary maneuvering of the vehicle into position for gaining control of the container, lifting, dumping, shaking and replacing the container into position even if the vehicle moves the container location, or moves from underneath utility lines before dumping. Lifting time ends when the vehicle begins reverse movement after replacing the empty container into position. Lifting time is expressed in decimal minutes and differs for each vehicle. Lifting time is assigned from the chart in Figure 4. It should not be misconstrued that this is the actual vehicle capability since it includes allowances for operator variables, container placement and topographical conditions. Actual lift capability is compared to performance in the field in Figure 10.

TRUCK NO.*	RATED VOLUME	NET CALC. VOLUME	V_t (cu yds)	L_n (min.pr. cycle)	C_t (min. per compaction)
246	30	31.1	27.99	1.04	.78
247	30	28.4	25.46	.51	.92
248	42	42.9	38.61	.95	.48
264	32	27.7	24.93	.60	.55
266	32	30.3	27.27	.54	.89
269	32	32.9	29.61	.69	.56
2401	32	30.0	27.00	.71	.63

* Trucks are briefly described at the end of this appendix.

FIGURE 4. VEHICLE VOLUME, LIFTING TIME, AND COMPACTION TIME

(b) Egress Time (E_t)

The time for egress begins with the reverse motion of the vehicle away from the container and includes all steering, turning and maneuvering in forward and reverse movement necessary to begin the final forward motion toward the next container. Very specifically, it concludes when the vehicle begins its final forward motion toward the next container. There are four types of egress generally described as shown in Figure 5. Each container is assigned a type based on the best estimate of the analyst. Although this is somewhat arbitrary, our distribution of observations shows that the vast majority of containers fall into types one and two.

Comparative data for vehicles and egress time are shown in Figure 10. The average varies somewhat reflecting route conditions. However, the median and mode are indicators of vehicle capability and are consistent enough to consider the egress type assigned to each customer to be a constant for all vehicles in Scottsdale.

(c) Frequency of Compaction (F_c) and Compaction Time (C_t)

Frequency represents the number of times the refuse is compacted in the vehicle while no other element of work is being performed concurrently. The value assigned is expressed as a fraction showing compactions per yards of refuse in a normal load. Since all Scottsdale vehicles can compact at any time, a constant of one compaction for every three loaded yards was adopted as a standard. Compaction time varies for each vehicle due to bin length and hydraulic ram speed and is not controllable by the

1 Time .15 min.	Minimum backing of vehicle required for extended lift arms to clear container when vehicle begins to move forward. Final forward motion begins immediately following the vehicles coming to a complete stop on the initial reverse movement. A maximum of fifty feet of forward movement is allowed in this category (Figure 6). Example: Containers in alley behind Golden Ox Apartments near Granite Reef & McDowell.
2 Time .40 min.	Simple direct reverse movement for a maximum of fifty feet onto a busy street with initial forward movement toward next container beginning on public access. Example: Circle K at Granite Reef & Chaparral; Yavapai School at 701 N. Miller. OR Simple direct reverse movement for a maximum of 150 feet onto a quiet street with initial forward movement toward next container beginning on public access. Example: Park Orleans Townhouse complex on Indian School.
3 Time 1.00 min.	Maximum of three forward and reverse maneuvers necessary to clear parked cars, curbs, sharp turns, utility poles, etc. before beginning final forward motion toward next container. Example: Motel 6 on Camelback; Pima Country Club. OR A combination of up to 100 feet of reverse movement together with one or two forward and reverse maneuvers necessary to begin final forward movement toward next container. Example: McCormick Ranch Restaurant; Diamond's at Fashion Square.
4 Time 1.5 min.	Excessive reverse movement (over 150') requiring turning and maneuvering around parked cars, utility poles, curbs, sharp turns, etc. beginning final forward movement toward next container. Example: Saguaro High School; Safari Hotel. OR Excessive forward and reverse maneuvers (four or more) necessary to clear parked cars, curbs, sharp turns, utility poles, etc. before beginning final forward motion toward next container. Example: Scottsdale High School; crowded shopping centers. OR A combination of up to 100 feet of reverse movement requiring turning and maneuvering around parked cars, utility poles, curbs, sharp turns, etc. together with three to five forward and reverse maneuvers necessary to begin final forward movement toward next container. Example: Safari Hotel; complicated townhouse complex.

FIGURE 5. TYPES OF EGRESS

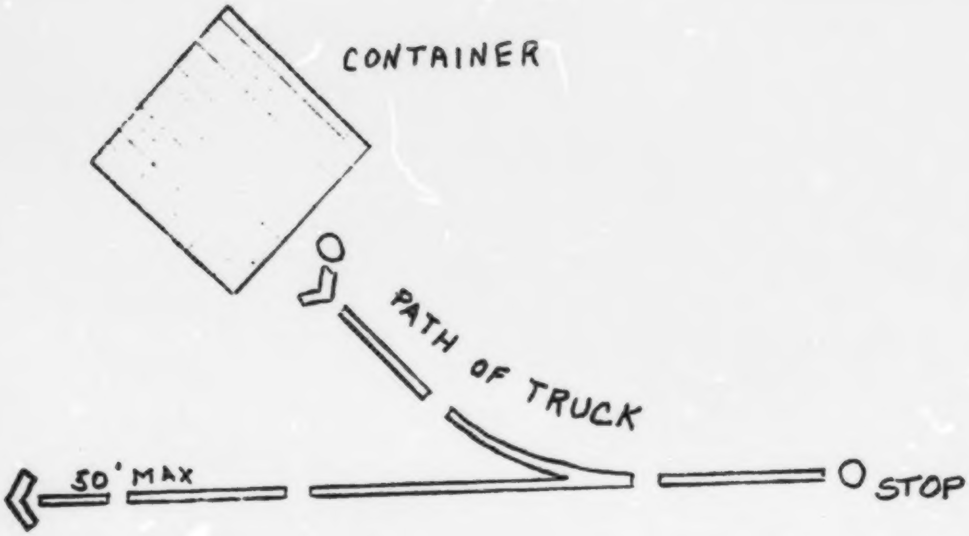
CONTAINER
PATH OF TRUCK
50' MAX
STOP

FIGURE IV-6. TYPE 1 EGRESS

operator. Consequently, this term was considered as a constant only for each vehicle and is shown in Figure 4. Comparative data for F_c and C_t is shown in Figure 10.

Note 1: For example, a thirty-yard truck experiencing ten compactions per load would have an F_c of 1/3 assigned, or one compaction for every three compacted yards of refuse. The data in Figure 10 shows a range of one compaction every 1.3 yards to one compaction every 6.0 yards for Scottsdale vehicles. The operator's work habits contributed significantly to this difference as well as the distance between containers allowing compaction to be achieved during travel time. (City of Mesa vehicles are allowed to compact only with the vehicle transmission in neutral). Route planning/or adequate distance between customers could optimize the frequency of compacting while on travel time but should be carefully evaluated for detrimental effects on other elements of work.

(d) Service Volume of Containers (V_c)

This is simply the size in cubic yards of the containers being serviced. All formulas in this study are based on 100% utilization of the container by the customer since route size and charges are based on maximum usage available to the customer. However, some sources have recommended that a 75% utilization factor be used at initial container selection and included in both formulas and

CITY OF SCOTTSDALE VEHICLES

VEHICLE NO.	TOTAL TIME	NUMBER OBSERVATIONS	AVG T_u	HIGH T_u	LOW T_u
246	84.49	7	12.07	17.40	7.95
247	71.72	5	14.34	17.96	8.28
248	87.38	6	14.56	18.00	12.89
264	94.29	6	15.72	18.45	11.98
266	95.37	7	13.62	16.83	10.67
269	99.17	6	16.53	20.03	11.10
2401	74.53	5	14.91	17.18	10.00
249	46.72	4	11.68	14.70	9.42
252	48.77	6	8.13	10.30	5.67
254	47.32	6	7.89	15.00	6.21
256	44.92	5	8.98	10.76	7.49
258	48.32	4	12.08	17.60	9.21
262	13.50	1	13.50	13.50	13.50
267	22.87	2	11.44	8.16	14.71
TOTAL	879.37	70	12.56		

CITY OF MESA VEHICLES

105	36.62	5	7.32	9.47	5.05
108	40.97	3	13.66	17.00	9.04
109	71.85	7	10.26	15.33	6.91
110	68.86	6	11.48	19.37	7.02
113	57.83	4	14.46	19.89	9.61
114	26.65	3	6.88	7.61	6.49
119	29.19	2	14.60	16.57	12.68
TOTAL	331.97	30	10.80		

FIGURE IV - 7. UNLOAD TIME BY VEHICLES

route determination.

(e) Gate Time (G_t)

Time for opening gates concealing containers or unlocking containers includes the average time for the operator to alight from the vehicle, open the gate, prop open if necessary, return to the vehicle then repeat the reverse process for closing the gate. Standard time for Scottsdale has been determined to be .90 minutes ($G_t = .90$) from ten observations totaling 9.03 minutes. Low time was .57 minutes and high time was 1.36 minutes.

(f) Roll Out Containers (R_t)

Time for moving roll out containers into position for dumping includes the average time for the operator to alight from the vehicle, roll out the container into position, return to the vehicle then repeat the reverse process for returning the container to its location. Standard time has been determined to be 1.06 minutes ($R_t = 1.06$) from twenty-seven observations totaling 28.72 minutes. The range was from .71 minutes low to a high of 2.16 minutes.

(5) Haul Time Assigned to Each Customer (T_{ha})

(a) Service Volume Available to Customer (V_{sa})

Service volume available to a customer is the sum of the bin sizes in cubic yards located at the customer. It is expressed in the formula in cubic yards. For example:

Bins	Yd^3	Total Yd^3
3	8	24
2	6	12
4	4	16
	V_{sa} =	52

(b) Vehicle Volume (V_t)

The usable volume of a vehicle body is obtained by physically measuring the inside body dimensions of each truck. A relatively small amount of the body volume is not usable due to the inability of the vehicle to fully compact the refuse dumped into the hopper when the vehicle is nearly loaded. V_t is presented in tabular form for each vehicle in Figure 4.

(c) Time to Unload at Landfill (T_u)

Time to unload at the landfill includes all time expended from the moment the vehicle turns onto the landfill access road until it returns to the rural thoroughfare. The factor includes round trip travel on the access road, checking in with the landfill custodian, maneuvering into position, unloading and cleaning the body of the truck. This time is determined by timing each vehicle for several cycles and averaging the total time. The T_u varies slightly for each vehicle due to bin size and design as well as hydraulic ram speed, however, the difference in operators cause a wider range of times. Consequently, a constant T_u of 12.56 minutes for all vehicles is used. (See Figure 8). This is a liberal allowance that could be reduced appreciably by correcting the cause of debris

ELEMENT	ESTIMATED TIME
Drive truck from access at Beeline to beginning of dump area	1.5 minutes
Maneuver truck into position to unload from beginning of dump area	1.0 minutes
Alight from truck, open doors, etc. and prepare vehicle for unloading	.7 minutes
Actuate ram and unload vehicle	1.5 minutes
Clean debris from rear gate and in front of ram plate	5.0 minutes
Button up truck and return to cab	.8 minutes
Drive truck from dump area to Beeline Highway	2.0 minutes
TOTAL	12.5 minutes

Obviously, the largest element of time estimated above is the five minutes for the operator to clean debris from the truck. This could be minimized by having a closer fit between the packer plate and the body and by more care by the operator when compacting as pointed out in the following section.

FIGURE 8

ESTIMATED TIME TO UNLOAD AT LANDFILL BY ELEMENT OF WORK falling forward of the packer plate or by modifying the truck to speed up the cleaning and allow it to be done less frequently. The time to unload consists of seven elements with the time for each estimated from the 132 observations as shown in Figure 8.

Conclusions

The study has shown that performance measurement for commercial refuse collection is feasible utilizing measurement techniques that have been applied in industry for years. Obviously, the use of modern EDP equipment is necessary for the timely and topical presentation of MIS reports from the data base. The initial cost of the data base and programming would be high. The perpetual maintenance of the data base would be mandatory if any degree of confidence in the system is to be maintained. The variable and constant data required is presented in Figure 9.

It should be cautioned that many of the values assigned to various subsegments in Section II have neither been through the computer model nor have they stood the test of time, therefore, they should not be taken literally at this time. However, the logic for determining the values is sound and only additional detail study is required to have a viable measurement system.

1. VARIABLE DATA TO BE ENTERED FOR EACH CUSTOMER

Name

Address

Comm. Route Number

Distance from prior customer to this customer (d_p)
  For first customer on route use half the distance from the corporation yard as shown in Figure 1.

Distance from this customer to next customer (d_n)
  Size of container (V_c)
  Repeat for each container on customer premises

Distance to container from public access (d_a)
  Repeat for each container on customer premises

Category of egress (E_t)
  Repeat for each container on customer premises

Refuse type for determining compaction ratio reciprocal (K_r), container size (V_c)
  Repeat for each container on customer premises

Roll out container -- yes or no
  Repeat for each container on customer premises

Open gate or unlock container -- yes or no
  Repeat for each container on customer premises
  Gate time (G_t) .90 minutes
  Roll out container time (R_t) 1.06 minutes

2. CONSTANT DATA

Miscellaneous and crew time (C_m) 91 minutes
Average vehicle speed for given distance (V_s)
Time to unload at landfill (T_u)
Frequency of compaction (F_c)
Compaction ratio multiplier (C_t) for each refuse type

3. CONSTANT DATA FOR EACH ROUTE

Truck normally assigned to route (vehicle serial number)
Distance to first customer on route
Urban distance from center of route (d_u)
Rural distance (d_r)

4. CONSTANT DATA FOR EACH TRUCK

Lifting time (L_n)
Usable volume of body (V_t)
Compaction time (C_t)

FIGURE 9. DATA BASE FOR PERFORMANCE MEASUREMENT

VEHICLE CHARACTERISTICS PERFORMANCE ON ROUTE (INFLUENCED BY OPERATOR & TOPOGRAPHICAL VARIABLES)

VEHICLE	TARE WEIGHT	AXLES	NET CALC. BODY SIZE (YDS^3)	LIFT CYCLE TIME	COM-PCTN. CYCLE TIME	TURN DIS-TANCE	AUX. ENG-INE	MANEUVER INTO POSITION. GAIN CONTROL OF CONTAINER WITH LIFT ARMS			MEDIAN	MODE	LIFT, DUMP, SHAKE, REPLACE CONTAINER			MEDIAN	MODE	EGRESS FROM CONTAINER TO FINAL FORWARD MOTION TO NEXT CONTAINER			MEDIAN	MODE	GO INTO LANDFILL, UNLOAD, CLEAN TRUCK, RETURN TRUCK TO HIGH-WAY			COMPACT OR PARTLY COMPACT REFUSE IN TRUCK WHILE STANDING STILL			YDS^3 PER COMPACTION CYCLE		
								No. Obs	Total Time	Avg. Time			No. Obs	Total Time	Avg. Time			No. Obs	Total Time	Avg. Time			No. Obs.	Total Time	Avg. Time	No. Obs.	Total Time	Avg. Time	No. Comp.	No. Yds^3	Yds^3 Per Comp.
246	33,400	3	31.1	.62	.95	57'2"	YES	116	21.50	.19	.17	.10	82	69.43	.85	.78	.71	122	47.90	.39	.20	.10	7	84.49	12.07	42	32.76	.78	42	126	3.0
247	27,400	2	28.4	.17	.35	39'8"	YES	72	14.02	.19	.16	.11	59	18.86	.32	.31	.32	69	17.02	.25	.20	.15	5	71.72	14.34	9	8.28	.92	9	54	6.0
248	36,900	3	42.9	.33	1.11	60'9"	YES	104	22.54	.22	.19	.16	101	74.13	.73	.67	.66	141	60.53	.43	.25	.15	6	87.38	14.56	62	29.48	.48	62	77	1.2
264	26,900	2	27.7	.30	.84	37'4"	NO	71	11.46	.16	.14	.10	48	20.93	.44	.41	--	71	16.31	.23	.15	.11	6	94.29	15.72	26	14.30	.55	26	50	1.9
266	26,500	2	30.3	.27	.90	45'7"	NO	42	6.59	.16	.12	.11	44	16.74	.38	.34	.30	45	7.65	.17	.13	.13	7	95.37	13.62	30	26.62	.89	13	23	1.8
269	27,400	2	32.9	.19	.38	38'10"	YES	54	11.04	.20	.20	.11	42	20.62	.49	.43	.35	52	20.49	.39	.23	.12	6	99.17	16.53	13	7.28	.56	13	52	4.0
2401	31,600	2	30.0	.32	1.12	37'6"	NO	110	23.34	.21	.17	.14	83	41.63	.50	.42	.35	103	23.07	.22	.16	.13	5	74.53	14.91	40	25.20	.63	46	59	1.3
			31.9	.31	.81			569	110.49	.19	.15	.14	459	262.34	.57	.43	.35	603	192.97	.32	.16	.15	42	606.95	14.45	222	143.92	.65	211	441	2.1
CITY OF MESA VEHICLES																															
105	32,290	3	30.0	.71	.70	Est 53'0"	NO	56	16.64	.30	.30	.31	56	46.89	.84	.82	.80	57	17.73	.33	.25	.20	5	36.62	7.32	24	17.55	.73	60	24	2.5
112	34,590	3	30.0	.90	1.01	same	NO	55	21.27	.39	.36	.28	48	49.41	1.03	1.00	.97	54	17.58	.33	.26	.27	-	--	--	19	21.78	1.15	19	48	2.5
113	31,870	3	30.0	.49	.62	same	NO	96	31.67	.33	.29	.28	95	81.03	.85	.80	--	98	35.76	.36	.26	.22	4	57.83	14.46	88	42.64	.48	88	90	1.0
114	33,700	3	30.0	.55	.65	same	NO	79	23.21	.29	.29	--	72	53.67	.75	.73	.73	78	25.72	.33	.27	--	3	26.65	6.88	27	19.85	.74	27	80	3.0
119	31,530	3	30.0	.60	1.40	same	NO	73	22.73	.31	.28	.24	64	51.84	.81	.79	.77	73	21.85	.30	.21	.20	2	29.19	14.60	32	34.44	1.08	32	80	2.5
	32,796		30.0	.65	.88			359	115.52	.32	.29	.24	335	282.84	.84	.82	.77	360	118.64	.33	.25	.20	14	150.29	10.74	190	136.26	.72	226	322	1.4
CITY OF SCOTTSDALE 3-AXLE VEHICLES ONLY																															
	35,150	3	37	.48	1.03	--	YES	220	44.04	.20	--	--	183	143.56	.78	--	--	263	108.43	.41	--	--	13	171.87	13.22	104	62.24	.60	104	203	2.0
CITY OF SCOTTSDALE 2-AXLE VEHICLES ONLY																															
	27,960	2	29.9	.25	.72	--	--	349	66.45	.19	--	--	276	118.78	.43	--	--	340	84.54	.25	--	--	29	435.08	15.00	118	81.68	.69	118	238	2.0

FIGURE 10. VEHICLE CHARACTERISTICS AND ROUTE PERFORMANCE

CITY OF SCOTTSDALE

CITY OF MESA

Comparison of Commercial Refuse Collection - City of Scottsdale - City of Mesa

While gathering field data at the landfill on Scottsdale vehicles the opportunity presented itself to compare the unloading work element of the formula with City of Mesa vehicles. When calculations revealed that Mesa vehicles outperformed Scottsdale vehicles on this segment, the City of Mesa agreed to additional comparative analysis.

Except for two vehicles, Scottsdale has single cab, two-axle trucks while Mesa uses double cab, three-axle models. One major difference, and the most significant factor, is that all Scottsdale vehicles are designed for operation of the hydraulic system while the vehicle transmission is in forward or reverse. Mesa vehicle transmissions must be in neutral while the hydraulic system is operated. The philosophy of Mesa is that the vehicle operator must handle the truck with extreme care to reduce the maintenance time. Scottsdale tends to push the vehicle to its limit and beyond to attain maximum performance on the route with resulting high maintenance and down time. Mesa emergency downtime is relatively insignificant. Scottsdale emergency downtime often impacts collections. Mesa operates two eight-hour shifts six days a week. Scottsdale operates one ten-hour shift four days a week. Mesa route size normally is less than 100 containers while Scottsdale normally has more than 150. Mesa operators are expected to fuel and clean the vehicle at the end of each shift. Scottsdale operators do not. Mesa has an individual incentive system with the operator allowed to go home when his route is completed. Scottsdale has a group incentive system with no operator allowed to go home until all routes are completed. The experience level in years is generally higher for Scottsdale operators.

For purposes of further specific comparisons the Scottsdale data will be for the two axle trucks only. See Figure 10 for all referenced data.

The most significant difference in the vehicles is in the operation of the hydraulic system. The average minimum lift cycle time was .25 minutes for Scottsdale compared to .65 minutes for Mesa. This raw capability can be compared to actual performance on the route by comparing to the "lift, dump; shake, replace container" column in Figure 10. Scottsdale trucks averaged .43 minutes per container or 58% of the vehicle ability. Mesa vehicles averaged .84 minutes per container or 77% of the vehicle capability.

Scottsdale vehicles averaged .19 minutes and Mesa vehicles averaged .32 minutes to Maneuver into Position. Gain control of container with Lift Arms." A small amount of the difference is due to better container placement in Scottsdale that minimizes the difference in vehicle maneuverability. However, the major difference is caused by the inability of Mesa vehicles to position the lift arms while the vehicle is in forward motion.

Comparison of "Egress From Container to Final Forward Motion to Next Container" shows Scottsdale vehicles average .25 minutes;

Mesa .33 minutes per container. The majority of the difference is caused by the necessity of Mesa operators to stop the vehicle and place the transmission in neutral to position the lift arms for travel.

A summary of these three segments of service time for each container follows and illustrates that Scottsdale vehicles service a container in .62 minutes less time than do Mesa vehicles.

Segment	Scottsdale	Mesa
Maneuver, Gain Control	.19	.32
Lift, Dump, Shake	.43	.84
Egress	.25	.33
Total	.87 min.	1.49 min.

The other area affected by the difference in the hydraulic system is compaction of the refuse. Mesa vehicles must be motionless with the transmission in neutral while compacting. Scottsdale vehicles can compact while traveling between containers if the distance permits. The result is that Scottsdale vehicles compact with the vehicle motionless once for each two compacted yards of refuse loaded. Mesa vehicles compact once for each 1.4 compacted yards of refuse loaded. This means that for each vehicle load, Mesa spends 18.48 minutes compacting only while Scottsdale spends 10.35 minutes or an improvement of 8.13 minutes per load over Mesa.

Mesa operators outperformed Scottsdale in unloading at the landfill. Scottsdale averaged 15.00 minutes per trip while Mesa averaged 10.74 minutes or an improvement of 4.26 minutes over Scottsdale. The hydraulic ram speed of the Mesa vehicles is slightly lower (.88 minutes) than Scottsdale (.72 minutes). The difference may be caused by two conditions:

(1) The individual incentive systems allowed Mesa operators and discussed earlier.

(2) The compaction plate on Scottsdale vehicles fits loosely in the body allowing refuse to spill over. Consequently, the operator must clean in front of the plate on every load to prevent littering of the highways. The Mesa operators minimize spillover during compacting by withdrawing the ram plate a few feet from the refuse two or three times during each compaction cycle. This allows potential spillover to settle down again behind the ram plate.

Mesa vehicles are capable of hauling a heavier payload as shown in the following comparison:

	Legal Load	
	Mesa 3-Axle	Scottsdale 2-Axle
	48,000	36,000
Average GVW	32,796	27,960
Average Payload	15,204	8,040

Mesa is averaging slightly over 10,000 pounds payload while Scottsdale averages over 8400 pounds.

It was thought that the turning characteristics of the vehicle would have significant impact on time required to service a customer.

From comparing the "Maneuvering into Position ...." column and "Egress From ......" column the conclusion is drawn that proper container placement can offset any advantages of a shorter turning radius in the flat desert terrain of Arizona.

APPENDIX V

SAMPLE CONTRACTS FOR COMMERCIAL REFUSE COLLECTION

SAMPLE CONTRACT FOR COLLECTION AND DISPOSAL OF CITY REFUSE *

THIS AGREEMENT, made and entered into this _______ day of _____________, between the CITY OF ________________, duly organized and existing under and by virtue of the laws of the State of _____________, hereinafter sometimes referred to as "CITY", and _____________, Inc. _____________________, a corporation doing business under the firm name of ______________________________, hereinafter sometimes referred to as "CONTRACTOR";

WITNESSETH

WHEREAS, at a public hearing, after receipt of many reports and recommendations and referring to many previous hearings and meetings, and after long discussion thereon, at a regular Council meeting held at ______P.M. on the ______ day of _________________, in the Council Chambers, City Hall, City of ___________, the City Council duly awarded this contract to ______________________________ upon the terms and conditions attached thereto.

NOW, THEREFORE, IT IS HEREBY MUTUALLY AGREED BETWEEN THE PARTIES HERETO AS FOLLOWS:

Contract and Terms:

1. This contract for the collection and disposal of refuse and rubble within the City of ____________________ shall be for the term of ten (10) years from and beginning with the ________ day of ____________________.

Definitions of Solid Waste:

1. Refuse: Garbage, rubbish, or both.
2. Garbage: Refuse accumulations of animal, fruit, or vegetable matter that attend the use and preparation of meat, fish, fowl, fruits or vegetables and tin cans originally used for foodstuffs.
3. Rubbish: All other refuse, crockery, bottles, tin cans, metal vessels, trimmings from lawns, trees, gardens, pasteboard boxes, berry boxes, rags, paper, straw, sawdust, packaging material, shavings, ashes, and similar materials.
4. Rubble: Rocks, concrete, bricks, and similar solid material, plaster, or dirt.
5. Standard Containers: Plastic or galvanized metal container, water-tight, with tight-fitting covers approximately thirty-two (32) gallons or less in capacity, with cover handle and side bails, or as otherwise approved by the City.
6. Bundle: A package containing rubbish only, not exceeding four (4) feet in its longest dimension, securely tied with cord or rope of sufficient strength to permit lifting and carrying of the full weight thereof without spillage or leakage and placed for collection immediately adjacent to a standard container.

Commencement - Bond - Insurance:

1. Contractor shall collect all refuse and rubble in the City of _____________

*"Sample Contract for Collection of City Refuse," in Sanitation Industry Yearbook, 1974, p. 24. Solid Waste Management Refuse Removal Journal, Nov. 1973.

and shall not charge any amount in excess of the rates set out herein.

2. Contractor shall furnish to the City of ________________ a Surety Bond in the sum of $100,000, conditioned upon the faithful performance of this contract, or may in lieu of such Surety Bond deposit the $100,000 with the City, and thereafter maintain said sum of $100,000 on deposit in lieu of such Surety Bond.

3. Contractor shall procure for the period covered by this contract, full compensation insurance with an "Insurance Carrier" as defined by and in accordance with the provisions of the Act of the Legislature of the State of __________, known as "Workmen's Compensation Act," approved ________________, __________ and as subsequently amended.

4. Contractor shall carry public liability insurance to the extent of Three Hundred Thousand Dollars ($300,000) for the death of or injury to one person, and One Million Dollars ($1,000,000) for the death of or injury to more than one person, and property damage insurance to the extent of One Hundred Thousand Dollars ($100,000) upon each of the trucks or other vehicles used by him in carrying out the work called for in the contract, such insurance expressly to cover both the City and the Contractor. A certificate showing that the contractor has in force and effect the aforesaid insurance covering both Contractor and said City shall be filed with the Clerk of the City of ___________ within ten (10) days from the execution of the Contract, and yearly thereafter at the execution of the Contract, and yearly thereafter at least thirty (30) days prior to the date of the expiration of said Policies of Insurance for each year of said Contract.

Collection Operations:

1. Contractor shall make a minimum of at least a twice-weekly collection of refuse from all residences and commercial and institutional establishments who subscribe with the contractor within the City of ________________. Contractor shall provide and use an adequate number and type of equipment approved by the City. All equipment shall be in the name of the Contractor.

2. Refuse collections shall be made between the hours of 7 a.m. and 6 p.m. in residential districts and shall be made for commercial customers between the hours of 4 a.m. and 12 midnight, subject to such reasonable modifications of collection periods as the City Council may impose. All collections shall be made as quietly as possible. Unnecessarily noisy trucks or equipment are prohibited.

3. Contractor shall not litter premises in process of making collections, nor allow any refuse to blow or fall from any vehicle used for collections. Contractor shall repair or replace at his expense containers damaged as a result of his handling thereof, fair wear and tear excepted. Contractors shall replace lids or covers on containers immediately after emptying.

4. Contractor shall supply the City with current maps and schedules of collection and disposal routes. Contractor shall supply the City daily with copies of all complaint reports and information as to their disposition. Contractor shall supply all occupants of premises with complaint procedures, rates, regulations, and days of collection.

5. Contractor shall provide special haul service to all occupants of premises within the City at the rates contained herein.

6. Contractor shall establish and maintain an office where refuse bills may be paid, service applied for and complaints made. Such office shall be equipped with sufficient telephones and shall have a responsible person in charge between the hours of 8 a.m. and 5 p.m. of each day, except Saturdays, Sundays and holidays.

7. Contractor shall maintain garaging and maintenance facilities for all equipment in a condition and at a location acceptable to the City insofar as zoning, traffic, home parking, and nuisance considerations are concerned. Contractor shall maintain all trucks in a clean and sanitary condition. Each truck shall be well-painted at least annually, and shall have clearly visible insignia designating the name of the contracting firm.

8. Contractor shall not use a firm name containing "City of ___________" or other words implying numicipal ownership.

Disposal Operation

1. All refuse, upon being removed from the premises where produced or accumulated and transported upon or over a public street, alley, lane, right of way or place, shall become and be the property of the Contractor.

2. Contractor may undertake organized salvage operations upon obtaining approval therefor of the City Council.

Rates:

1. For any services required to be performed under this contract Contractor shall not charge any amount in excess of the rates fixed hereunder until or unless such rate or rates are modified by action of the City Council, and amendment hereof.

2. For refuse collected and disposed of in the manner herein provided, the rates shall not exceed the following:

A. RESIDENCES: SINGLE-FAMILY, TWO-FAMILY, AND MULTIPLE.
Regular Service: Twice weekly collection

	Monthly Charge
One standard container	____________
Two standard containers per regular collection	____________
Each additional standard container per regular collection: single-family residence	____________
In the case of multiple or group dwellings other than motels, or hotels, there shall be at least two standard containers for each dwelling, or in the alternative a total equivalent volume in an approved container or containers designed for mechanical emptying.	
Extra charge per month for waling distance in excess of 125' from container location to curb or roadway edge.	____________
Monthly charges established above shall apply to standard containers, equivalent quantities of bundles, rubbish, or combinations thereof.	

B. COMMERCIAL AND INSTITUTIONAL ESTABLISHMENTS: HOTELS, RESTAURANTS, BOARDING HOUSES, OFFICE BUILDINGS, STORES, ETC.

Regular Service: Two to six collections per week as required for adequate service and approved by the City.

Unit Price

Each standard container of refuse, or equivalent quantity of garbage, per collection. __________

Each cubic yard of refuse in bins or boxes, per collection __________

C. Rates and charges established above shall be based upon the average quantities of refuse produced, and not necessarily varied with season variations in refuse production.

D. SPECIAL HAUL SERVICES:

Service: Collections as specially requested by occupants or owners, of amounts of refuse in excess of those normally collected and at pick up times other than normally scheduled:

Unit Price

Cost per cubic yard of refuse for total quantities up to 5 cubic yards __________

Cost per cubic yard of refuse for total quantities exceeding 5 cubic yards __________

Refuse to be collected on special haul service need not be in containers or bundled, but shall be piled at a convenient place, on private property, for truck pickup.

3. The Contractor may petition the City for rate adjustments on the basis of the cost of living index established and promulgated by the U.S. Department of Labor nearest and next prior in point of time to each one year interval dates, and such adjustments shall deem December 1, 1964, to be the base point of such "cost of living index," and the Council shall upon receiving documented proof of same give the Contractor a rate increase based on the above formula.

Contractor's Personnel:

1. The City may, at its option, request finger-printing and also request the right of prior approval of employment of any person by Contractor whose services will enter into performance of this contract.

2. Employees driving Contractor vehicles shall each at all times possess and carry a valid commercial vehicle operator's license.

3. Contractor's employees shall be required to wear clean clothing of uniform type and color as approved by the City.

4. The City may request the dismissal of any employee of the Contractor who violates any provision hereof, or who is wanton, negligent or discourteous in the performance of his duties.

Financial and Accounting:

1. Contractor shall bill all occupants or owners bimonthly on forms approved by the City. The Contractor may bill for longer intervals with customer approval.

2. Contractor shall guarantee and pay to the City a minimum annual amount of $7,000. Such revenue shall be available for the cost of policing and inspection services by the City. The City shall uniform all personnel assigned to the enforcement of this contract.

3. Contractor shall, upon execution of this contract, deposit and maintain with the City at all times a minimum of Five Hundred Dollars ($500.00) to be placed in a Service Guarantee Fund. Such deposit shall be restored monthly when billed and shall be returned to the Contractor upon the expiration of this contract. The City may make withdrawals from such Fund to cover costs of any complaint investigation or pickup services by the City caused by the Contractor's failure to render service as required herein. The Contractor will receive interest annually on the average amount on deposit equal to that received by the City from the deposit thereof.

Administration:

1. The administration and enforcement of this contract shall be the responsibility of the City of ____________. It shall be the responsibility of the City Council to see that refuse service customers are provided at all times with complete information about the service.

2. The City Council shall recommend for adoption by the Council, in resolution form, any rules and regulations required to enforce or carry out the terms and conditions of this contract.

3. The City shall establish and fill a position, uniform same, and appoint as a special officer whose duties shall include full-time supervision and inspection of Contractor's operation to assure strict compliance with all provisions hereof and any rules and regulations adopted pursuant hereto. The Contractor's equipment shall be inspected at a point designated by the Special Officer during June and December of each year of this contract, and shall certify that the Contractor's equipment conforms to regulations of the Motor Vehicle Code of the State of _________ and the Ordinances of the City of ____________.

Each vehicle hauling refuse in the City by the Contractor shall carry a fire extinguisher in accordance with the specifications approved by the City Fire Department and shall be inspected every June and December of each year of this contract.

Also, the garage facilities will have adequate fire extinguishers on the premises at all times in accordance with the specifications approved by the City Fire Department.

The Special Officer shall enforce the health and fire ordinances of the City of ________________, relative to this contract's definition of refuse, garbage, rubbish, rubble, etc.

City Enforcement:

The City intends to use diligence in enacting and enforcing regulations pertaining to the obligations of owners and occupants of premises as follows:

1. It shall be unlawful for any person other than this Contractor or its agents or employees to collect refuse, or rubble, or to interfere in any manner with any receptable containing refuse, rubble, or the contents of any refuse container, or to remove any such receptacles from the place where same are placed by the owner or person lawfully in control thereof, or to remove the contents of such receptacles, Anyone who shall deposit their refuse or anyone else's refuse in someone else's container other than their own container shall be deemed guilty of a misdemeanor and upon conviction thereof shall be punishable by a fine of not more than $500 or by imprisonment in the city jail for a period of not more than six (6) months or by both such fine and emprisonment. Nothing in this contract shall be construed to prevent the owner of his or her own-generated refuse or rubble within the City limits from transporting the same personally to an approved municipal disposal site.

2. Any and all person or persons in possession, charge of or control of any boarding house, restaurant, cafe, hotel, apartment, eating house, dwelling house, multi-family dwelling, court, commercial establishment, flat, or owning or occupying any premises whatsoever, or having refuse within the City of ____________, shall provide, or cause to be provided, and at all times keep or cause to be kept suitable and sufficient standard containers for the deposit of refuse and rubble from premises or containers.

Any and all such persons who subscribe to regular collection and disposal services by Contractor for the removal and disposal of refuse and rubble from premises or containers.

The number of containers provided and the amount of regular service retained by occupants or owners of premises shall be sufficient to take care of the refuse and rubble normally produced or originating from or upon the premises during intervals between collections without spillage, escape of odors, or otherwise creating a nuisance. All containers shall have the lid tightly closed.

3. No refuse or rubble container or bundle shall be placed or kept on or in any public street, alley, sidewalk, footpath, or any public place whatsoever but shall be placed and kept on the premises in such manner as to be readily accessible for removal of contents therefrom by Contractor.

4. Contractor shall be entitled to payment in advance for the collection of refuse and rubble from each such occupant or owner.

5. Owners or occupants of premises shall locate containers on private property, at curb, alley or at the rear or side of residences, multiple unit premises, or commercial or institutional buildings.

6. Containers shall be easily accessible to Contractor for collection, preferably in a paved area.

7. Containers shall be kept in a sanitary condition by owners or persons in possession or control thereof. Covers shall not be removed, except for the purpose of placing refuse therein or removing refuse therefrom.

8. Refuse or rubble placed in standard containers shall not exceed a weight of eighty (80) pounds, including any such container and contents.

9. Except at commercial or institutional premises and special haul service, no refuse shall be placed for collection unless in standard containers or in securely tied bundles as defined herein.

10. Refuse to be collect-d by special haul service shall be placed so as to be easily accessible to the collector. Special haul refuse may be placed for collection in other than standard containers or bundles.

11. Rubbish placed outside of standard containers at commercial or institutional premises shall be placed in a standard bin or box approved by the City and Contractor but must meet specifications of the health and fire ordinances of the City of ______________. Any such bin or box shall be easily opened for rubbish removal by Contractor.

12. Containers, bins, or boxes shall not be filled beyond the point at which lids can be tightly closed.

13. Containers used at multiple unit premises shall be plainly marked so that the owner or person in possession or control thereof may be easily identified for billing purposes.

14. Service complaints shall be directed initially to the Contractor.

15. It shall be unlawful to deposit or use refuse for lot filling or leveling purposes.

16. An owner and occupant of any premises from which refuse is generated may haul refuse and rubble to an authorized municipal designated sanitary fill-site.

17. All refuse and rubble hauled by the Contractor or any person over public streets in the City of _____________ shall be securely tied and covered during hauling thereof so as to prevent leakage, spillage or blowing. No person shall refuse or rubble of any kind whatsoever to leak, spill, blow or drop from any vehicle on to any public street within said City.

18. The purpose of this section is to regulate those haulers such as professional "gardeners" only.

It shall be unlawful for anyone in this profession to haul refuse beyond the extent that would be construed as applicable to gardening and that a gardener, himself, would generate from the premises of his client and resulting from his own gardening work.

19. It shall be unlawful for any person to bury refuse at any place within the City of ______________ or to keep, place or deposit refuse on any public or private grounds or premises whatsoever, except in containers or receptacles, for collection upon premises owned, occupied, or under possession and control of such person, provided, however, that lawn and garden trimmings may be composted.

20. It shall be unlawful to create, cause, or add to any refuse accumulation not placed for regular or special haul, or to cause unwholesome odors, or to cause the attraction or collection of insects or rodents, or to burn any garbage, leather, rubber, plastic, green or wet vegetation or organic material, or to burn any other substance producing smoke problems or odor problems within the City of ____________.

Miscellanoues:

Provisions of this contract shall be interpreted to attain the object hereof to the end that all reasonable quantities and types of refuse placed for collection are collected.

2. Contractor shall not enter into any subcontracts, leases, agreements, or assignment of or pertaining to this collection and disposal contract, or any interest

or right herein, either voluntarily or by operation of law, without prior written approval of the City of ______________.

3. It is agreed that in the event Contractor shall be adjudged bankrupt, either by voluntary or involuntary proceedings, then this contract shall immediately terminate, and Contractor shall have the right forthwith to terminate said Contract, and in no event shall this contract be, or be treated as, as asset of Contractor after adjudication of bankruptcy. If Contractor shall be proven insolvent, or fail in business, then this contract may be terminated at the option of the City, in which event City shall have the right to immediately re-enter possession or purchase Contractor's operating equipment and records, and in no event shall this contract be or be treated as, an asset of Contractor after the exercise of said option. As set out, it is agreed that this contract is not assignable by Contractor, either voluntarily or involuntarily, or by any process of law, except as above provided, and shall not be or come under the control of creditors, or trustee, or trustees of Contractor in case of bankruptcy, or insolvency of Contractor, but shall be subject to termination as above provided.

4. Contractor shall comply with all laws, ordinances, rules and regulations relating to performance of this contract, use of premises and public places and safety of persons and property. The Contractor shall obtain, at his own expense, all permits and licenses required by law or ordinance and maintain the same in full force and effect.

5. It is the intention and agreement of the parties to this contract that all legal provisions of law required to be inserted herein, shall be and are inserted herein. However, if by mistake or otherwise, some such provision is not herein inserted, or is not inserted in proper form, then upon the application of either party, the contract shall be amended so as to strictly comply with the law without prejudice to the rights of either party.

6. It is the understanding and intentions of the parties hereto that this agreement shall consitute a contract for the collection and disposal of refuse and rubble, that said contract shall not constitute a franchise, nor shall the same be deemed or construed as such.

7. All terms, and conditions, of the contract are considered material and failure to perform any of said conditions on the part of Contractor shall be considered a breach of said contract. Should Contractor fail to perform any of said terms or conditions, the City shall have the right to terminate the contract, only after ten (10) days notice in writing to the Contractor of the violation of the contract and the failure of the Contractor to remedy the violation within said time.

8. In the event of termination of the contract for breach or default by Contractor as above specified, the City shall have the right to forthwith take possession of all trucks and other equipment of Contractor for the purpose of collecting, hauling and disposing of refuse and rubble which Contractor has agreed to haul. The City shall have the right to retain possession of all said trucks and equipment until other suitable trucks and equipment can be purchased or otherwise acquired by the City for such purpose, and the City shall in case of any such termination have the right of purchase of Contractor's equipment and facilities at the depreciated fair market value thereof shaould it elect to purchase. The City shall pay Contractor the reasonable rental value of such trucks and equipment during the time the same are used by the City for said purpose should it elect not to purchase. In case of termination and City operation, the City

shall have access to Contractor's records for the purpose of billing and shall rebate all payments and funds received for the period during which the City is providing service.

IN WITNESS WHEREOF, the parties hereto have executed this contract, consisting of _____ pages, in duplicate, the day and year first above written.

CITY OF ______________________
By __________________________

MAYOR ______________________
City of ____________________

____
Name of Sanitation Service Company

By ___________________________
President

Local Address: ________________ (street address)

Telephone: __________________

CONTRACTOR
APPROVED AND COUNTERSIGNED

____
____
____

APPROVED: DATED: __________________________

____

____
(CITY ATTORNEY)

COMPACTOR AGREEMENT *

PROVIDES FOR INSTALLATION, MAINTENANCE AND SERVICING A PACKER UNIT

MEMORANDUM OF AGREEMENT made this _____ day of ___________ between the _______________________and _________________(hereinafter referred to as the "Contractor") whose address is ____

WHEREAS _______________________desires to engage the services of the Contractor on the terms and conditions hereinafter set forth, and

WHEREAS the Contractor represents he is qualified, ready and willing to accept this engagement of service with _________________ and the said terms and conditions:

NOW, THEREFORE, the parties hereto agree as follows:

1.00 NATURE OF SERVICES

1.01 The Contractor undertakes to provide the following services and equipment:

A. Install at a place on _____________'s premises and in a manner to be agreed upon by ____________ and the Contractor, a refuse compacting apparatus having a minimum container capacity of _______________ cubic yards (_______ cu. yds.) of loose material compacted. This apparatus shall be new and unused.

B. Furnish the labor, cartage and all other equipment and facilities as shall be deemed necessary by _____________ to remove the compacted refuse from the premises of _________________ and to dispose of same.

C. Furnish such number of containers for reception of wastes as it is necessary by _________________ to ensure the uninterrupted removal of refuse from _____________'s premises.

D. Maintain the said compacting apparatus containers and associated equipment in serviceable condition throughout the duration of this Agreement.

E. In the event of breakdown of said compacting apparatus furnish upon demand by ___________such conventional solid wastes disposal services as shall be required to ensure no undue accumulation of refuse is caused by such breakdown, and shall at his own expense make all necessary repairs to the said compacting apparatus as promptly as possible.

F. The Contractor shall ensure the compacting apparatus, associated equipment and the immediate vicinity of the compacting apparatus are maintained free from odor resulting from this form of collection or the placing and holding of solid wastes in the compacting apparatus.

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*"Compactor Agreement," in Sanitation Industry Yearbook, 1974, p. 56. Solid Waste Management Refuse Removal Journal, Nov. 1973.

1.02 The Contractor in fulfillment of Article 1.01-E above, shall furnish ____________ with as many metal containers as may be required by the volume of refuse to be removed under this Agreement. Such containers shall have hinged covers and casters, and shall each be of _____________(____) cubic yard capacity. Said containers shall remain the property of the Contractor, and any depreciation, maintenance, repair and/or replacement thereof shall be for his account.

1.03 For the purposes of this Agreement the terms "refuse, wastes, solid wastes" shall include but not be limited to waste basket trash, cartons, boxes, crates, scrap, debris, scrap paper, carpeting, metals, cans, bottles, glass, lamps, wood scrap, waste building materials, restaurant garbage, salable waste paper and other materials resulting from activities within the _____________'s site; these terms however, shall not include steel scrap of such dimension as might consitute a hazard to the compactor, bulky construction debris, lumber or wood in excess of 4" x 4" x 36", or solid soil from gardens.

1.04 Nothing contained in this Agreement shall be deemed a warranty express or implied by ______________to make available for removal by the Contractor a minimum or maximum amount of refuse from the premises.

1.05 The Contractor shall provide open truck clearances on demand of __________ at a fixed rate of $_________ per cubic yard.

1.06 Open truck clearances shall be defined as being all clearance specifically requested by _____________ which necessitate the use of an open truck for the clearance of materials which cannot be handled by the compacting apparatus or conventional garbage disposal service referred to in Articles 1.01-A and 1.01-E respectively.

2.00 FREQUENCY OF SERVICE

2.01 The services to be furnished under Article 1.02 of the Agreement shall be of such frequency as to ensure that adequate container space shall be available at all times.

2.02 For the services referred to in Article 1.01 of this Agreement pickups shall be made by the Contractor every day of the week from Monday to Saturday inclusive, and, if specifically requested by ___________ on Sundays. The number of pickups on each day shall be as required by _______________ and shall not necessarily be restricted to daylight hours. No compensation over and above that specified in Article 3.01 and Article 3.02 below shall be payable to the Contractor for pickups made during Saturdays, Sundays, holidays, nights or any other times.

3.00 PAYMENT

3.01 In full and complete consideration of the performance by the Contractor of his obligations under this Agreement ___________ shall pay the Contractor for his services:

A. Under Article 1.01-A, B, C, D and F - the flat rate of _________ Dollars ($________) for each container of __________ (____) cubic yards of loose refuse compacted and removed from __________'s premises; or

B. Under Article 1.01-E - the flat rate of _____________ Dollars ($____) per cubic yard of loose garbage removed from __________ premises.

3.02 The charges set forth in Article 3.01 above cover all services, labor, equipment and facilities including but not limited to the compactor, containers, insurance coverage as is required and "emergency" service referred to in Article 1.01-E of this Agreement.

3.03 Within one week from the end of each calendar month the Contractor shall submit to ____________ an invoice for the volume of wastes removed during the previous month. Within one week after its receipt ________________ shall pay the amount specified in said invoice.

3.04 It is agreed that the prices set forth in Article 3.01 above are based on the wage scale as determined by the Contractor's union contract. Should a new contract result in wage scale or rates of pay affecting the Contractor's prices set forth in Paragraph 3.01 above will be subject to adjustment to the extent that the costs of wastes removal are increased or decreased by such new contract. Any increase in the social security contribution payable during the term of this Agreement by the Contractor in respect of his employees directly engaged in the performance of services under this Agreement shall be borne by ________________. Also, the said prices will be subject to adjustment to the extent that the costs of the dumping of refuse are increased or decreased by charges imposed on the Contractor by the ________________. Teh Contractor will notify ______________ immediately of any modifications to the prices set forth in Paragraph 3.01 above. The Contractor, at the request of ____________, will promptly supply ________________ with full information and details, together with all pertinent documentation, of the methods of determining any new price.

4.00 WARRANTIES BY CONTRACTOR

4.01 The Contractor warrants he holds valid _______________ and other required dumping permits and agrees to maintain the same and to comply fully with all laws, regulations, and ordinances applicable to the services to be provided by the Contractor under this Agreement.

4.02 The Contractor shall maintain for the duration of this Agreement such insurance as shall adequately protect the Contractor, his employees and agents, and ________________, its employees and agents, from claims under Workmen's Compensation Acts and in addition, public liability insurance against the risks of damages for personal injury, including death, or for damage to property, both real and personal, which may arise from operations under this Agreement, whether such operation be by the Contractor or by anyone directly or indirectly employed by him. The Contractor shall deliver to ____________ at the time of signing this Agreement evidence in the form of Certificates of Insurance that he is complying with the provisions of this Article.

4.03 The Contractor agreeing that time is of the essence warrants the compacting apparatus and associated equipment shall be installed and operating on _____________ premises in accordance with the terms and conditions of this Contract by not later than ________________, _______________.

5.00 STATUS OF CONTRACTOR

5.01 The Contractor shall be deemed to be an independent contractor for purposes of this Agreement. Accordingly, neither the Contractor nor any of his employees shall be considered an agent, employee, or servant of ___________, and the Contractor agrees to indemnify and hold ____________ harmless from any claims by its employees in connection with the performance by such employees in connection with the performance by such employees of services under this Agreement.

5.02 The Contractor shall indemnify, hold and save harmless and defend at its own expense ________________, its officers, agents, servants, and employees from and against all suits, claims, demands, and liability of any nature or kind, including costs and expenses arising out of acts or omissions of the Contractor or its employees in the performance of this Contract. This clause shall extend to claims or liability in the nature of workmen's compensation claims or liability or those arising out of the use of patented inventions or devices.

6.00 DURATION

6.01 This Agreement shall be deemed to have entered into full force and effect as of ______________, ______________, and unless extended by mutual agreement in writing at least thirty (30) days prior to its termination date, this Agreement shall terminate on ______________, __________.

7.00 TERMINATION

7.01 In the event of non-fulfilment or unsatisfactory execution by the Contractor of any of his obligations under this Agreement, _____________shall give notice in writing to the Contractor and give the Contractor such time as may be reasonably required to set right the matters under complaint. If at the end of such reasonable period of time the Contractor has not rectified the complaint, ____________shall have the right to terminate this Agreement forthwith.

7.02 Repeated failure of compacting apparatus referred to in Article 1.01 above shall constitute a cause for termination of this Agreement.

7.03 Failure on the part of the Contractor to install said compacting apparatus and associated equipment and to commence operations not later than _____________, _____________, shall constitute grounds for the immediate cancellation of this Agreement by ______________.

8.00 ARBITRATION

8.01 Any dispute arising out of the interpretation or application of the terms of this Agreement shall, unless it is settled by direct negotiations, be referred to arbitration in accordance with the rules, then obtaining, of the American Arbitration Association. The parties agree to be bound by any arbitration award rendered in accordance with this article as the final adjudication of any such dispute.

9.00 NON-WAIVER OF IMMUNITIES

9.01 Nothing in this Agreement shall be deemed a waiver of any of the privileges or immunities of _____________.

10.00 MISCELLANEOUS PROVISIONS

10.01 The Contractor shall not advertise or otherwise make public the fact that it is a contractor of ______________, and shall in no other manner whatsoever use the name, emblem, or official seal of ______________ or any abbreviation of the name of the latter in connection with its business or otherwise.

10.02 The compacting apparatus referred to in Article 1.01 above shall be subject to a thirty (30) day trial period during which period ______________ shall have the right to order the apparatus modified, resited or removed from ____________'s premises, at no cost to ____________. The thirty (30) day trial period shall commence as of the date the said compacting apparatus commences operation under the terms of this Agreement.

10.3 During the trial period referred to in Article 10.02 above the Contractor shall furnish if required, adequate conventional refuse disposal services as stipulated in Articles 1.01-E and 1.02 above.

10.04 The Contractor agrees that Contract (____________) shall be automatically terminated upon successful completion of the 30 day trial period referred to in Article 10.02 of this Agreement and acceptance of the compacting apparatus by ____________________.

10.05 In the event this Agreement is terminated for whatsoever reason, the Contractor shall continue to furnish either compacting or conventional refuse disposal services whichever is deemed necessary by ________________ to ensure the continual satisfactory disposal of solid wastes from ______________'s premises, for a period of thirty (30) days from the date the notice of termination is issued, it being understood that the Contractor shall be paid during this period at the rates specified in Article 3.01 above.

10.06 ________________ agrees to install at its own cost all fixtures and facilities necessary to provide current to the compacting apparatus. The cost of electricity provided for the operation of the compacting apparatus shall be payable by ______________.

10.07 ______________agrees that for so long a time as this Agreement shall remain in effect and the Contractor shall perform his obligations in a manner and to an extent satisfactory to ____________, no other person, firm or coporation will be granted the privilege of removing refuse from the premises of _____________.

11.00 AMENDMENTS OR ADDENDUMS

11.01 No amendment or addendum to this Agreement shall be binding unless made in writing and duly executed by the parties hereto.

____
(Contractor)

By ___________________________________
Title:

____
(Account Served)

By ___________________________________
Title:

SAMPLE CONTRACT FOR PRIVATE HAULER SERVICE [1]

MEMORANDUM of Agreement between ______________________________
______________________________, ______________________________ hereinafter
(address) (city)
referred to as "Center" and ______________________________
(contractor)
______________________________ ______________________________ hereinafter
(address) (city)
referred to as the "Contractor."

Whereas the Center desires to engage the services of the Contractor for the period ______________________________ to ______________________________
(starting date) (termination date)
related to the collection and disposal of solid waste from ______________________________; and

Whereas the Contractor is prepared and able to render above mentioned services to the Center on the terms and conditions set out in this Agreement;

Now therefore, this Agreement witnesseth that, in consideration of the Convenants herein contained, the Center and the Contractor hereby agree as follows:

1. SCOPE:

A. The Contractor undertakes to provide the Center with solid waste collection and disposal services, and for this purpose to furnish the labor, storage containers, equipment, and facilities necessary to remove solid wastes from the premises of the Center and to dispose of same. For purposes of this Agreement, the term "solid waste" shall include, but shall not be limited to, spoiled and culled fruits and vegetables, produce trimmings, cartons, boxes, crates, debris, paper, wood, and restaurant wastes resulting from activities within ______________________________

B. Solid wastes to be removed shall be placed on the loading platforms or in the loading areas, from which the Contractor will load its trucks. The Contractor shall be responsible for avoiding spillage or scattering of solid wastes over the loading platform or loading area floors, and shall remove and broom clean such spillage should it occur.

C. The Contractor will furnish each tenant of the Center as many metal containers as may be required by the volume of solid waste to be removed and in any event a minimum of 1. Such containers shall have hinged covers and casters, and shall be of 2-cubic-yard capacity each. These containers will remain the property of the Contractor, and any depreciation, maintenance, repair and replacement thereof shall be for his account.

2. FREQUENCY OF SERVICE

Pickups for the purpose of removing solid waste will be made by the Contractor every day of the week from Monday to Saturday inclusive. Each tenant shall be provided service a minimum of twice each week. The number of pickups will be as required, to the end that undue accumulation of solid waste will not occur on the loading platform or in the loading area. All collections shall be made daily between the hours of ______________ and ______________.
(time) (time)

3. CONSIDERATION

A. In full and complete consideration of the performance by the Contractor of his obligations under this Agreement, the Center shall pay to the Contractor:

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[1] Adapted from "A sample contract for commercial or industrial pickup," in Sanitation Industry Yearbook. Ed. 8, p. 6. Solid Waste Management Refuse Removal Journal. 1971.

(1) In 1971—a fixed sum of $__________.

(2) In 1972—a fixed sum of $__________.

(3) In 1973—a fixed sum of $__________.

B. The above payments shall cover all labor, equipment, and facilities, including containers and required insurance coverage under this Agreement, and shall not be subject to increase during the entire period of this Agreement on any grounds, whether for increases in the cost to the Contractor of labor, insurance, equipment, materials, licenses, taxes or the type or quantity of solid waste; or for any other reason whatsoever.

C. Sums payable to the Contractor under this Agreement will be paid to it in 12 equal monthly installments. Within one week after the end of each calendar month, the Contractor will submit to the Center an invoice certifying that it has performed the services herein for the previous month. Within one week after its receipt, the Center will pay the Contractor the installment corresponding to the month covered by such invoice.

D. The Contractor shall not be entitled to any payment which is not expressly provided for in this Agreement.

4. WARRANTIES BY CONTRACTOR

A. The Contractor warrants that it holds valid all required dumping permits and agrees to maintain the same and comply fully with all laws, regulations and ordinances applicable to the services to be provided by it hereunder.

B. The Contractor shall maintain for the duration of this Agreement such insurance as will adequately protect the Contractor, its employees and agents, and the Center, and tenants, their employees and agents, from claims under Workmen's Compensation Acts and other claims for damages for personal injury, including death, or for damage to property, both real and personal, which may arise from operations under this agreement, whether such operation be by the Contractor or by anyone directly or indirectly employed by it. The Contractor also shall indemnify and hold the Center, and tenants, their employees and agents harmless in respect of any and all such claims. Contractor shall deliver at the time of signing the form of Certificates of Insurance that he is complying with the provisions of the above paragraph.

C. The Contractor shall not employ any labor or use any material which may be the cause of a strike on the Center site.

5. STATUS OF CONTRACTOR

The Contractor shall be deemed to be an independent contractor for purposes of this Agreement. Accordingly, neither the Contractor nor any of his employees shall be considered an agent, employee or servant of the Center, and the Contractor agrees to indemnify and hold the Center harmless from any claims by its employees in connection with the performance by such employees of services under this Agreement.

6. APPLICABILITY TO NEW BUILDINGS CONSTRUCTION

As provided for in point 3 above, the price payable to the Contractor hereunder shall not be subject to increase for any reason. Nothwithstanding those provisions of point 3 and the preceding sentence, however, in the event of construction of new buildings within the present Center area, which directly results in an increase of 20 percent or more in the average volume of solid waste, the Contractor shall be entitled to an additional payment for the increase in volume of solid waste, the amount of which additional payment shall be mutually agreed upon by the Parties at that time, provided that the Center reserves the right to engage other contractors to undertake removal of the additional solid waste attributable to such new building construction activities in the event that the Parties are unable to agree on a satisfactory additional fee, and provided further that the mere fact that new construction is commenced within the present Center area shall not constitute a basis for renegotiation or alteration of any other provision of this Agreement.

7. DURATION

This Agreement shall be deemed as having entered into force as of ______(date)______ and unless extended by mutual agreement in writing not later than thirty (30) days prior to its termination date, this Agreement shall terminate on ______(date)______.

8. TERMINATION OF AGREEMENT

In the event of non-fulfillment or unsatisfactory execution by the Contractor of any of his obligations under this agreement, the Center shall give notice in writing to the Contractor and give the Contractor such time as may be reasonably required to set right the matters under complaint. If at the end of such reasonable period of time the Contractor has not rectified the complaint, the Center shall have the right to terminate this Agreement forthwith.

9. MISCELLANEOUS PROVISIONS

The rights and obligations of the Contractor under this Agreement shall not be assignable.

10. AMENDMENTS

1. No amendment to this Agreement shall be binding unless made in writing and duly executed by the Parties hereto.

Accepted:	(Contractor)		(Center)
By:		By:	
Title:		Title:	
Date:		Date:	

APPENDIX VI

MANAGEMENT INFORMATION & COST ACCOUNTING SYSTEM

APPENDIX VI

MANAGEMENT INFORMATION AND COST ACCOUNTING SYSTEM

Introduction

An essential element of any commercial refuse collection system, whether public or private, is a method to monitor activities, measure productivity, and evaluate operations. Even a simple management information and cost accounting system provides an empirical base for decision-making, allowing managers at all levels a means of confirming or disproving common-sense "hunches" or suspicions they may have. Although the Management Information and Cost Accounting System in Scottsdale is still in the developmental stage, the value of the information derived from it has more than offset the cost of development. As one of the objectives of this grant the city developed a simple Management Information System that can be used by commercial collection systems. The program can be run on computers having a 32K Core or more capacity and can be obtained from E.P.A.

Uses

Basically, there are three major uses for a MIS. To begin with, the MIS is a planning tool. Performance data can be projected to define the future resources needed to meet anticipated increases in either level or scope of service. The alternative types of equipment, scheduling, and management structure can be examined for potential improvements and savings.

Second, the MIS is a management tool. The number of customers, containers, trucks, miles driven, tons collected--all of these data are useful in evaluating present operations, procedures and methods. Excaptions to the "normal" give managers insights into improved performance or problem-solving.

Finally, the Management Information System is integrated into the cost accounting system to provide useful information for several purposes. To begin with, the cost of refuse collection indicates the total revenues that need to be generated in order to assure solvency or profit. Second, the detailed performance and route information provides a basis for assigning costs to customers, i.e., an equitable user charge system. Third, performance characteristics of a given vehicle can be assigned a dollar value, and thus, provide a true comparative criterion to be used in equpiment evaluation and selection.

Data Collection

The type, amount, and detail of data collected depends on the informational needs of the system, the unique characteristics of the system, and the uses to which the MIS is put. In general, however, all systems keep information on the following components:

(1) The customer; his name, address, collection characteristics, etc.

(2) The containers; their size, location, age, etc.

(3) The equipment; the type, utilization, cost of operation, etc.

(4) The route; the customers on it, the distance to and from the yard and the landfill, the cost of collecting it, etc.

An examination of each of these components, and the information needed to establish a MIS, follows. Before doing so, it should be emphasized that most existing commercial refuse collection systems have already gathered much of the data necessary to establish a MIS, and thus it is simply a matter of organizing the data into a usable format and transferring to EDP (Electronic Data Processing) equipment and forms.

Customer file: The customer file contains information about the customers in the commercial refuse collection system--their needs, the type of refuse they generate, etc. Each customer is put on the system by filling out the "Customer File Maintenance" Sheet on Form VI-1. The necessary information concerning a customer is gathered by collection personnel and the finance department.

The following information is gathered about each customer:

(1) Name and address: Should be the name to which the bill is to be sent, as well as the Zip code (necessary for billing purposes). The name is assigned an account number, which is subsequently entered on the file.

(2) Number and size of containers: Size is expressed in cubic yards.

(3) Frequency of collection requested: Once a week, twice a week, etc. This will determine to some extent how and which routes the customer will be assigned to.

(4) Refuse type and SIC Code: From standard classification tables. See Table VI-1. - explanation.

(5) Service and travel time: This is determined by actual observation, after the containers are installed, for each route.

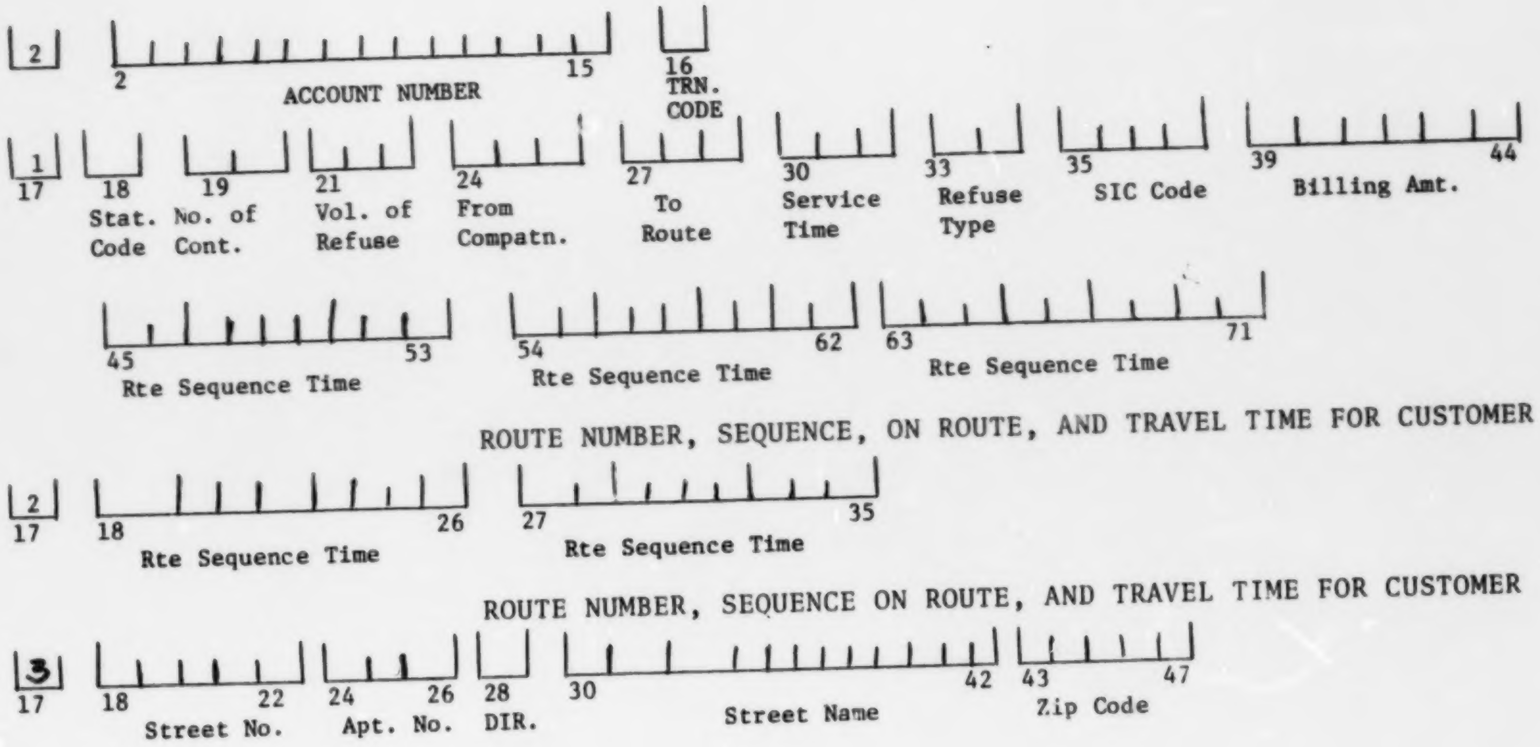
TABLE VI-1

SOLID WASTE
COMMERCIAL CLASSIFICATION SYSTEM

REFUSE TYPE	COMMERCIAL CLASSIFICATION	COMPOSITION TABLE 1	COMPACTION RATIO	AVG. DENSITY (LBS/CU YD)	SOURCE (STANDARD INSUSTRIAL CLASSIFICATION CODE)
1	Residential	Garbage, rubbish, ashes, street refuse	5.0:1	112	(6513)(6561)(7011)(7021)(7031)
2	Commercial	Rubbish, ashes, bulky wastes, street refuse	6.5:1	96	(4225)(5012)(5065)(5086)(5251) (5331)(5411)(5462)(5591)(5611) (5712)(5732)(5912)(6011)(6323) (6531)(7215)(7231)(7251)(7399) (7542)(7622)(7641)(7933)(8011) (8021)(8211)(8221)(8222)(8242) (8621)(8661)
3	Service Stations	Bulky waste, rubbish	4.5:1	127	(5541)
4	Hospitals	garbage, special wastes, rubbish	6.0:1	102	(8061)(8071)(8072)(8092)
5	Restaurants	garbage, street refuse, rubbish	5.5:1	101	(5421)(5431)(5812)(5813)
6	Light Industry	Bulky wastes, ashes, rubbish, street refuse	2.4:1	240	(1611)(1731)(2111)(2261)(2351) (2791)(3611)(3631)(3674)(4911)
7	Heavy Industry	Rubbish, Industrial refuse, construction & demolition waste	1.8:1	350	(1611)(1621)(1741)(1795)(2611) (2631)(2651)(3011)(3211)(3269) (3275)(3312)(3321)(3351)(3411) (3491)(3531)(3551)
8	Agriculture	Chemical & Agricultural wastes	3.0:1	201	(0135)(0712)(0715)(2011)(2015) (2020)(2042)(2051)(2099)
9	Compacted Materials	Varies	0.8:1	500	Any business establishment that utilizes an on-site compactor prior to collection.

Transaction Code
1 = set up record
2 = change record
3 = delete record

Status Codes
1 = in service
2 = discontinue


2
2
15
ACCOUNT NUMBER
16
TRN.
CODE
1
17
18
Stat.
Code
19
No. of
Cont.
21
Vol. of
Refuse
24
From
Compatn.
27
To
Route
30
Service
Time
33
Refuse
Type
35
SIC Code
39
44
Billing Amt.
45
53
Rte Sequence Time
54
62
Rte Sequence Time
63
71
Rte Sequence Time
ROUTE NUMBER, SEQUENCE, ON ROUTE, AND TRAVEL TIME FOR CUSTOMER
2
17
18
26
Rte Sequence Time
27
35
Rte Sequence Time
ROUTE NUMBER, SEQUENCE ON ROUTE, AND TRAVEL TIME FOR CUSTOMER
3
17
18
22
Street No.
24
26
Apt. No.
28
DIR.
30
42
Street Name
43
47
Zip Code

FORM VI-1. Commercial Refuse System Customer File Maintenance

(6) Route assignment: Based on customer location in relationship to the existing customers in the vicinity.

After the above information is gathered the customer is assigned an account number.

In the summary, then, the following elements comprise the customer file shown as Exhibit VI-1.

FIELD SIZE	DESCRIPTION
14	Account number identifying each customer
27	Service address
2	Total containers for this customer
2	Maximum volume of refuse for the customer
2	Compacted volume of refuse for this customer
6	Compaction ratio for this customer
5	Travel time between customers for this customer
3	Total service (access) time for this customer
4	Standard Industry Code
5	Billing amount
6	Route and sequence number for each route this customer is on.

Container File: The container file inventories all containers by customer, refuse type, and purchase and servicing dates. The following information is gathered for all containers, and entered in the "Container File" Sheet, as shown as Form VI-2:

(1) Container Number: All containers are numbered upon receipt. This number is painted on the container for ease in identification.

(2) Customer Account Number: When a customer is assigned a container the customer's account number is entered.

(3) Cubic Yard Size: Self-explanatory.

(4) Refuse Type: The type of refuse to be deposited in the container.

Transaction Code
1 = set up record
2 = change record
3 = delete record

3 1	2 5 Contr. Number	6 Tr Code	7 20 Account Number	21 Cu Yd Size	23 Ref Type	25 30 MO DAY YEAR Last Serv Date	31 36 MO DAY YEAR Purchase Date	37 Cont. Style
3 1	2 5 Contr. Number	6 Tr Code	7 20 Account Number	21 Cu Yd Size	23 Ref Type	MO DAY YEAR 25 Last Serv 30 Date	MO DAY YEAR 31 Purchase 36 Date	37 Cont. Style
3 1	2 5 Contr. Number	6 Tr Code	7 20 Account Number	21 Cu Yd Size	23 Ref Type	MO DAY YEAR 25 Last Serv 30 Date	MO DAY YEAR 31 Purchase 36 Date	37 Cont. Style
3 1	2 5 Contr. Number	6 Tr Code	7 20 Account Number	21 Cu Yd Size	23 Ref Type	MO DAY YEAR 25 Last Serv 30 Date	MO DAY YEAR 31 Purchase 36 Date	37 Cont. Style
3 1	2 5 Contr. Number	6 Tr Code	7 20 Account Number	21 Cu Yd Size	23 Ref Type	MO DAY YEAR 25 Last Serv 30 Date	MO DAY YEAR 31 Purchase 36 Date	37 Cont. Style
3 1	2 5 Contr. Number	6 Tr Code	7 20 Account Number	21 Cu Yd Size	23 Ref Type	MO DAY YEAR 25 Last Serv 30 Date	MO DAY YEAR 31 Purchase 36 Date	37 Cont. Style

FORM VI-2. Commercial Refuse System Container File Maintenance

(5) Service Date: Date of most recent container service

(6) Purchase Date: Self-explanatory

(7) Container Style: Open-top, close-top, compactor, etc.

In summary, the data elements in the container file, (Exhibit VI-2), with their field size, is as follows:

FIELD SIZE	DESCRIPTION
13	Unique number identifying each customer
4	Unique number for each container
2	Size of container
6	Date container was purchased
6	Date container was last serviced (maintained)
2	Type of refuse in container
2	Style of container

Equipment File: The equipment file contains information relative to characteristics of each vehicle used in the refuse collection operation.

The following information is gathered on Form VI-3:

(1) Vehicle number: Each vehicle is identified by a digit number

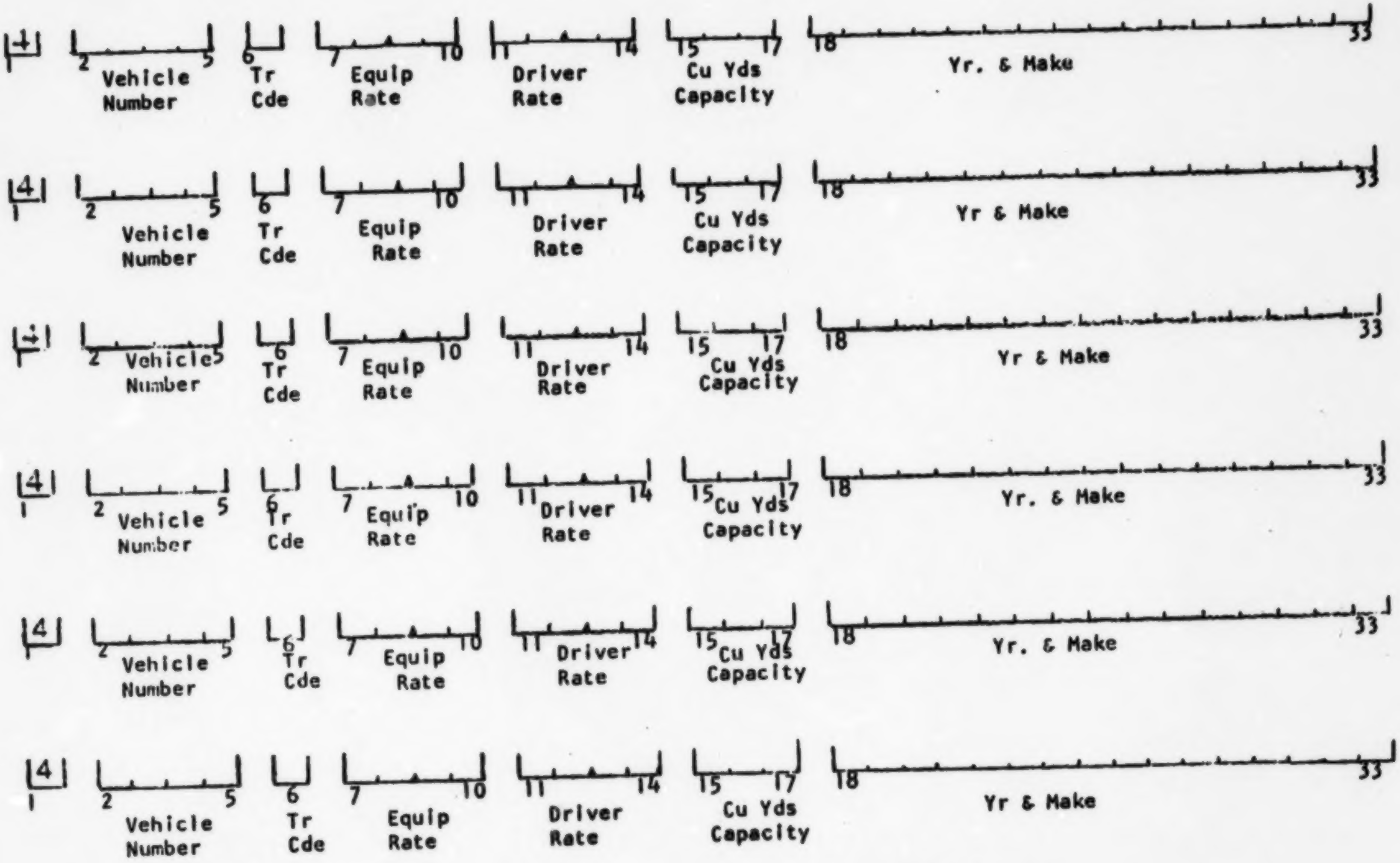
(2) Equipment rate: Equipment rate is a per-hour cost obtained by summing operating and depreciation costs. Operating costs are based on historical data.

(3) Driver rate: This is a per-hour rate based on average budgeted payroll for all collection drivers.

(4) Cubic yd. capacity: The rated capacity of the truck in cubic yards.

(5) Year and make: The year of the vehicle and manufacturer.

TRANSACTION CODES
1 = Set up record
2 = Change record
3 = Delete record


4
1
2
Vehicle Number
5
6
Tr Cde
7
Equip Rate
10
11
Driver Rate
14
15
Cu Yds Capacity
17
18
Yr. & Make
33

FORM VI-3. Commercial Refuse System Equipment File Maintenance.

The City keeps actual cost records through MAINSTEM, and equipment cost accounting system put out by MAINSTEM, INC. of New Jersey. The MAINSTEM System tracks costs on all city-owned vehicles for operation and maintenance. Copies of the MAINSTEM report are shown in the equipment considerations portion of the handbook.

This type of reporting and cost system is extremely valuable in monitoring equipment for operational purposes and for replacement evaluation. A similar system can be simplified and kept manually for small operations using similar data elements.

In summary, the equipment file (Exhibit VI-3) contains the following information and field sizes:

FIELD SIZE	DESCRIPTION
4	Unique number identifying each vehicle
5	Hourly rental rate for this vehicle
20	Name and year of this vehicle
3	Total cubic yards of capacity
4	Man hourly rate

Route File: The route file contains information that can be combined with customer and equipment characteristics to arrive at unit cost data. Much of the detailed route information is inputed from the customer file. The "Route File" Sheet (Form VI-4) gathers only that information concerning the general characteristics of the route.

TRANSACTION CODES

1 = Set up
2 = Change
3 = Delete

1 1	2 Route No.	4 Tr Cde	5 Trvl Time Frm Yd-Rte	7 Trvl Time Frm Rte-Yd	9 Tr & Dp Tim Frm Rt to Ldfl & Bk	11 Non Pdctv Time	13 M	14 T	15 W	16 T	17 F
									Pick up days		
1 1	2 Route no.	4 Tr Cde	5 Trvl Time Frm Yd-Rte	7 Trvl Time Frm Rte-Yd	9 Tr & Dp Tme Frm Rt to Ldfl & Back	11 Non Pdctv Time	13 M	14 T	15 W	16 T	17 F
									Pick up days		
1 1	2 Route No.	4 Tr Cde	5 Trvl Time Frm Yd-Rte	7 Trvl Time Frm Rte-Yd	9 Tr & Dp Tme Frm Rt to Ldfl & Bk	11 Non Pdctv Time	13 M	14 T	15 W	16 T	17 F
									Pick up days		
1 1	2 Route No.	4 Tr Cde	5 Trvl Time Frm Yd-Rte	7 Trvl Time Frm Rte-Yd	9 Tr & Dp Tme Frm Rt to Ldfl & Bk	11 Non Pdctv Time	13 M	14 T	15 W	16 T	17 F
									Pick up days		
1 1	2 Route No.	4 Tr Cde	5 Trvl Time Frm Yd-Rte	7 Trvl Time Frm Rte-Yd	9 Tr & Dp Tme Frm Rte to Ldfl & Back	11 Non Prdctv Time	13 M	14 T	15 W	16 T	17 F
									Pick up days		
1 1	2 Route No.	4 Tr Cde	5 Trvl Time Frm Yd-Rte	7 Trvl Time Frm Rte-Yd	9 Tr & Dp Tme Frm Rt to Ldfl & Bk	11 Non Pdctv Time	13 M	14 T	15 W	16 T	17 F
									Pick up days		

FORM VI-4. Commercial Refuse System Route File Maintenance

The information gathered is as follows:

1. Route Number: A two-digit number identifying the route.

2. Transaction Code: Whether the information to be inputed sets up, changes, or deletes a route.

3. Travel time from yard to route: The time it takes to get from the route to the first customer.

4. Travel time from route to yard: The time it takes to return to the yard from the landfill after the final load or customer.

5. Haul time: Travel time to and from the route to the landfill and dumping time.

6. Non-productive time: Lunch breaks, check-in, check-out

7. Pick up Days: Day(s) that route is serviced.

In summary, the equipment file (Exhibit VI-4) contains the following information and field sizes:

FIELD SIZE	DESCRIPTION
2	Unique number identifying each route
2	Travel time from yard to route
2	Travel time from landfill to yard
3	Nonproductive time (coffee breaks, etc)
5	Day(s) that route is serviced
3	Total containers on route
4	Maximum volume of refuse yds. (summary of all containers on route by size)
4	Compacted volume of refuse yds. (summary of compacted volume of all containers)
3	Total number of customers on this route
5	Total travel time between customers on this route
3	Total service (access) time for all customers on this route
3	Total haul time for one trip to landfill

Initial Data Gathering

The information needed to establish a MIS as previously pointed out, is largely gathered. However, some initial surveying will be necessary. The input form on page VII-5 of the User Charge System can be expanded to include other pertinent information. In addition, the reader is referred to the section on performance measurement for assistance in determining data collection methodology.

The cost and time of initial data collection may seem both excessive and tedious. While that may be true to some extent, both time and cost should be "depreciated" out over the useful life of the information to obtain a more accurate picture of the true costs of good management information.

File Input Summary

In summary, the information gathered for establishment of each of these four files is primarily background or general information. Each of the files has information that relates to the other files, and thus comprehensive management information results from integrating these files through programming.

The data collected for these files is collected primarily at the time an MIS is established. Much of it is relatively stable, and will not be changed or updated any more often than on an annual basis. Information such as depreciation costs, operational costs, salaries, time to and from the route, etc. will be modified on a budgetary cycle to reflect new salary and rate schedules.

File Output Reports

Forms VI-1 through VI-4 are used to update the information on the different files. These files are printed out as exhibits VI-1 through VI-4 on a periodic basis for use as work sheets. They describe the present status of customers, equipment, containers, and routes.

After forms VI-1 through VI-4 are completed they are sent to Data Processing for key punching. The key punched data for all four files is loaded to tape and sorted into account number sequence. The sorted tape is then applied to the programs that update each of the Disc Master Files. Data from these up-dated files may be accessed by applying the program that prints the Master File. A separate listing of each of the four files is produced and are labeled as such. Totals of selected items are accumulated and displayed at the end of both the customer and container file reports. A graphic presentation (flow chart) of this process is presented in exhibit VI-5.

These file output reports, in and of themselves, provide mainly descriptive information giving the scope of operations. Truly analytical data is provided by the cost accounting system, which utilizes the file content to show detailed cost analysis.

```
                                              COMMERCIAL REFUSE                                                  PAGE 13

                                               CUSTOMER FILE                  DATE 06/10/74

  ACCOUNT              SERVICE ADDRESS               ROUTE &    TRAV  NO.  MAX  COMP  COMPACT      REFUSE       SIC   BILLING  STAT
  NUMBER                                             SEQUENCE   TIME  CON  VOL  VOL   RATIO     TYPE/DENSITY        AMOUNT

                                                     99/ 30.0    .7
90033450725000  14501  N 073RD ST         85257      23/ 40.0    .2    1    4    1    6.5/ 1.0   02    96     5037    $.00     1
                                                     99/ 40.0    .2
90033450750011  14615  N 073RD ST                    23/ 41.0    .3    2   10    4    2.4/ 1.0   06   240     3611    $.00     1
                                                     99/ 41.0    .3
90033450790011  07301  E RUTHERIS                    23/ 46.0    .7    2    8    1    5.5/ 1.0   05   101     5812    $.00     1
                                                     99/ 46.0    .7
90033450800006  07333  E HELM                        23/ 43.0    .6    1    5    2    2.4/ 1.0   06   240     3611    $.00     1
                                                     99/ 43.0    .6
90034450240001  97600  RUTHERIS                      23/ 48.0    .8    2   12    2    6.5/ 1.0   02    96     7399    $.00     1
                                                     99/ 48.0    .8
```

Exhibit VI-1. Customer File Output Report

```
                              COMMERCIAL REFUSE                            PAGE  14

                                CUSTOMER FILE              DATE 06/10/74

TOTAL NUMBER OF CONTAINERS           418

TOTAL MAXIMUM VOLUME OF REFUSE     1,913

TOTAL COMPACT VOLUME OF REFUSE       386

TOTAL BILLING AMOUNT               56.11

TOTAL INSERVICE ACCOUNTS             235

TOTAL INACTIVE ACCOUNTS                0
```

Exhibit VI-1. (Cont.)

```
                              COMMERCIAL REFUSE                                  PAGE  62

                               CONTAINER FILE              DATE 06/10/74

CONTAINER        ACCOUNT        CONTAINER     REFUSE     PURCHASE      LAST SERV
 NUMBER          NUMBER         SIZE/STYLE     TYPE        DATE          DATE

  1676       90012453605008       05/           02         /  /          /  /
  1677       90013436047503       05/           02         /  /          /  /
  1678       90015451160001       05/           03         /  /          /  /
  0680       90018436800009       05/           02         /  /          /  /
  1681       90019450020006       05/           02         /  /          /  /
  1682       90019450020006       05/           02         /  /          /  /
  1684       90023470005005       03/           02         /  /          /  /
  1685       90032470005005       03/           02         /  /          /  /
  1686       90023470005005       03/           02         /  /          /  /
  1687       90023470005005       03/           02         /  /          /  /


 TOTAL NUMBER OF CONTAINERS 1,545
```

Exhibit VI-2. Container File Output Report

```
                              COMMERCIAL REFUSE                                 PAGE   1

                               EQUIPMENT FILE          DATE 06/10/74

VEHICLE     RENTAL      DRIVER      CAPACITY          VEHICLE
NUMBER       RATE        RATE       CUBIC YD         YEAR/MAKE

 0248       15.80        9.81         42.9        69 INTL BOWIES

 0264       15.80        9.81         27.7        72 DRESSEL

 0269       15.80        9.81         32.9        73 WESCO JET
```

Exhibit VI-3. Equipment File Output Report

```
                                                                                              PAGE   1
                                           COMMERCIAL REFUSE
                                              ROUTE FILE                    DATE 06/10/74

ROUTE   TRAVEL   TRAVEL   NON-PROD   PICK-UP     TOTAL      MAX   COMPACT   TOTAL   ROUTE    TOTAL      DUMP
 NO.     TIME     TIME      TIME      DAYS     CONTAINER    VOL     VOL      CUST   TRAVEL   ACCESS     TIME
        YD-RTE   RTF-YD              MTWTF                                           TIME     TIME    PER TRIP

 08        2       14        60          X        151       762     147       35      48      213        54
 20        3       13        76        X          123       479     105      111      30       60        46
 23       14       14        43       X           139       644     129       86      65      207        49
 99       14       14        43         X         144       672     134       89      92      213        49
```

Exhibit VI-4. Route File Output Report

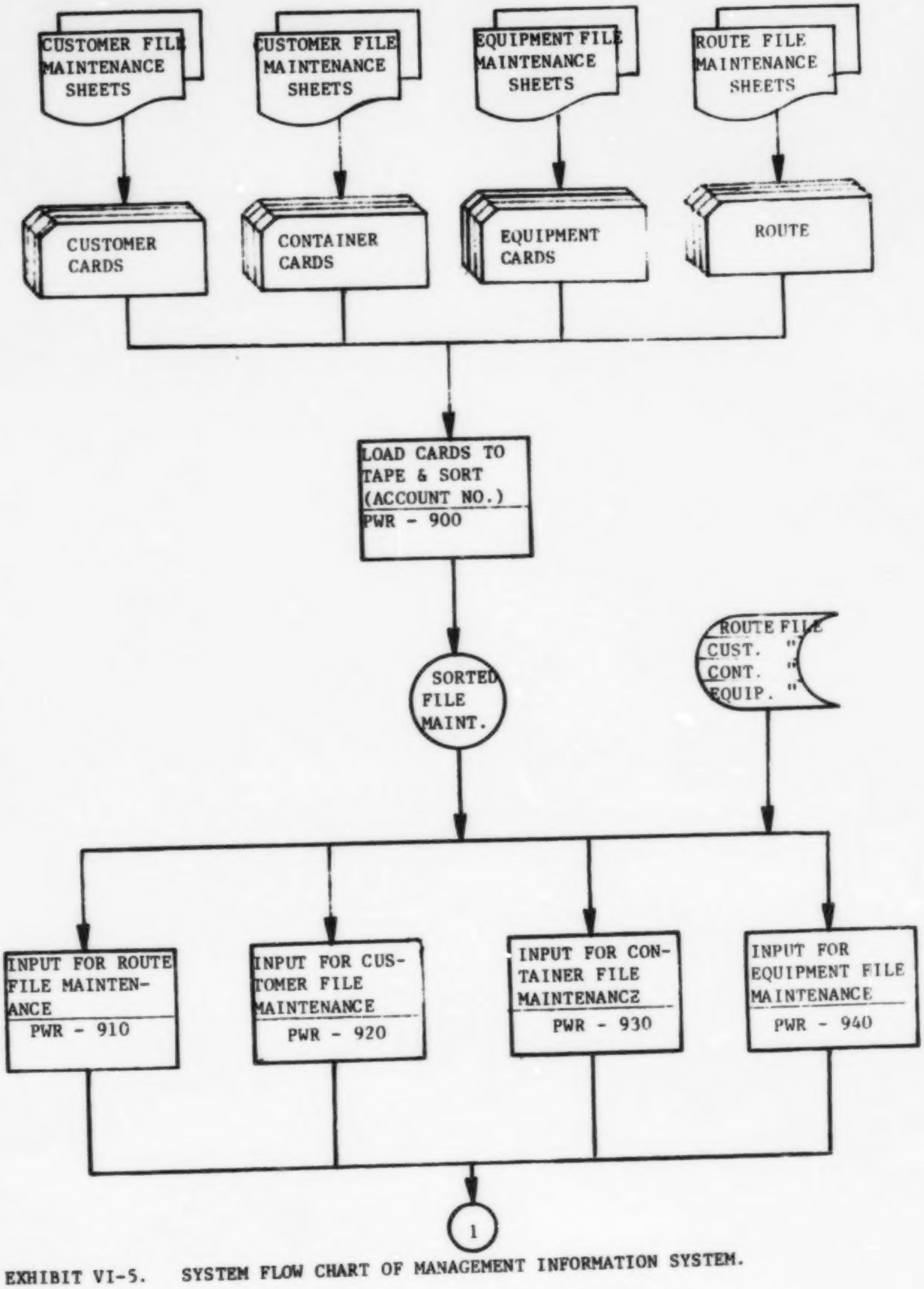

CUSTOMER FILE MAINTENANCE SHEETS
CUSTOMER FILE MAINTENANCE SHEETS
EQUIPMENT FILE MAINTENANCE SHEETS
ROUTE FILE MAINTENANCE SHEETS
CUSTOMER CARDS
CONTAINER CARDS
EQUIPMENT CARDS
ROUTE
LOAD CARDS TO TAPE & SORT (ACCOUNT NO.)
PWR - 900
SORTED FILE MAINT.
ROUTE FILE
CUST. "
CONT. "
EQUIP. "
INPUT FOR ROUTE FILE MAINTENANCE
PWR - 910
INPUT FOR CUSTOMER FILE MAINTENANCE
PWR - 920
INPUT FOR CONTAINER FILE MAINTENANCZ
PWR - 930
INPUT FOR EQUIPMENT FILE MAINTENANCE
PWR - 940
1

EXHIBIT VI-5. SYSTEM FLOW CHART OF MANAGEMENT INFORMATION SYSTEM.

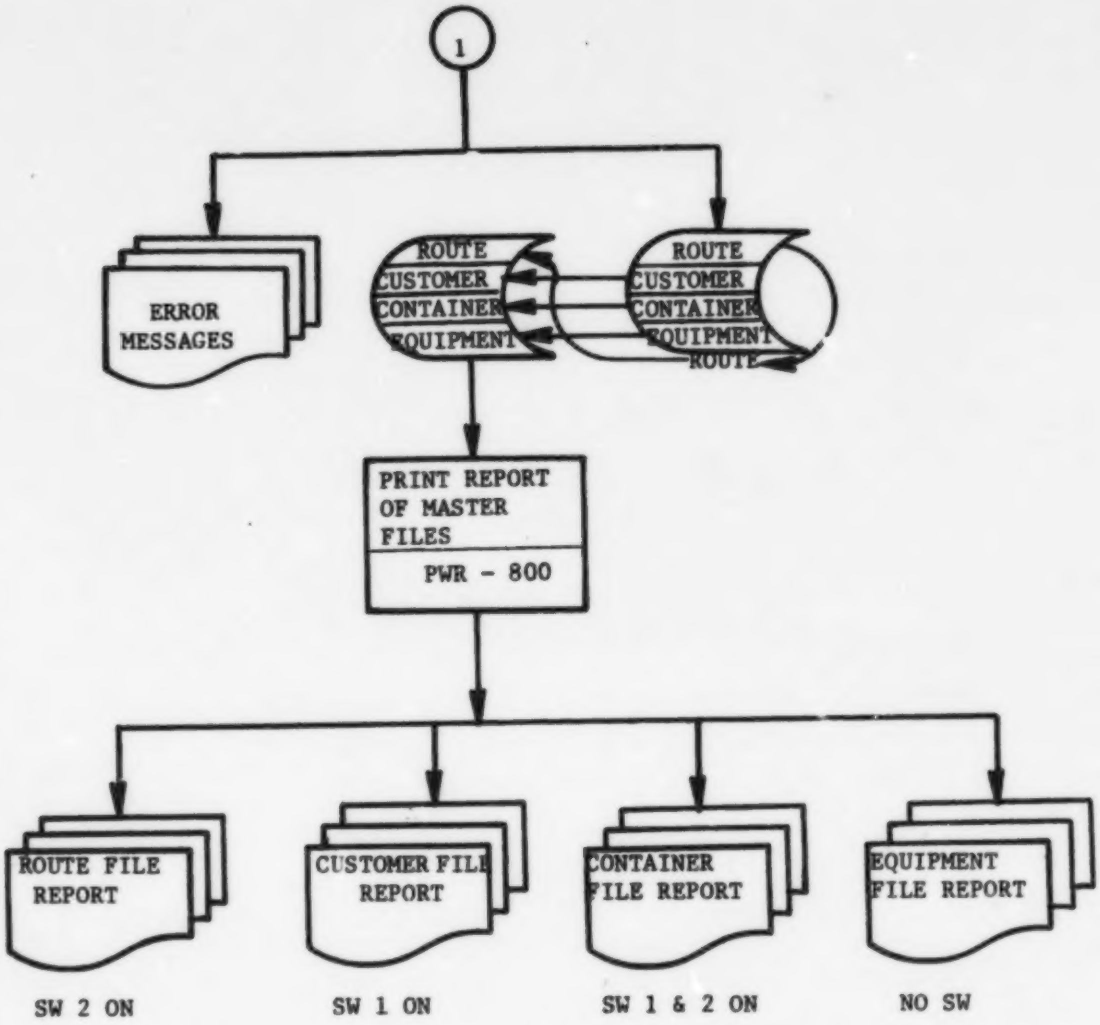

1
ERROR MESSAGES
ROUTE
CUSTOMER
CONTAINER
EQUIPMENT
ROUTE
CUSTOMER
CONTAINER
EQUIPMENT
ROUTE
PRINT REPORT OF MASTER FILES
PWR - 800
ROUTE FILE REPORT
CUSTOMER FILE REPORT
CONTAINER FILE REPORT
EQUIPMENT FILE REPORT
SW 2 ON
SW 1 ON
SW 1 & 2 ON
NO SW

EXHIBIT VI-5 CONTD.

Operational Information

The next step to establishing a MIS is to devise a simple, straight-forward method to collect operational data, i.e. information concerning the daily activities performed by the collection vehicle and driver on the route. This is done through a "Daily Activity" sheet that is filled out by either the driver and/or a clerk for the commercial refuse program (Form VI-5). The Daily Activity Sheet is designed to be simple, easy to fill out, and brief. The information input each day for each driver is as follows:

(1) Date and day: both are necessary because loads are heavier after the weekend.

(2) Route, vehicle and Driver: Matches equipment and personnel with the route.

(3) Time elements: There are basically three time elements:

  a. Total time, from start to end of shift
  b. Load time for each load
  c. Down time

(4) Cubic Yards and tons dumped: Total by load and for the day.

This information can be gathered in several ways. To begin with, the background information such as day, date, route, driver, and vehicle can all be entered by a secretary or clerk. Time elements can be filled in by the driver, as he proceeds on his route, or by the secretary if the collection vehicles are equipped with radio communications. Finally, cubic

________6 Date
7____ Day
9____ Rte
11________ Vehicle
15________19 Driver

Leave Motor Pool — Time ☐

LOADS:

	Start Time	Finish Time	Total Time	Cu. Yds. Dumped	Tons Dumped
1st	☐	☐	☐	☐	☐
2nd	☐	☐	☐	☐	☐
3rd	☐	☐	☐	☐	☐
4th	☐	☐	☐	☐	☐
5th	☐	☐	☐	☐	☐

Breakdown Time

Start ☐
Finish ☐
Total 20________22

Return to Motor Pool — Time ☐

23________26 Total time

27________29 Total Route Time
30________32 Total Cu. Yds Dumped
33________35 Total Tons Dumped
36 O/T

FORM VI-5. Commercial Refuse System Daily Activity yards and tons dumped are measured at the landfill entrance through the use of scales and observations.

In summary, the "Daily Activity" sheet provides a simple but effective means of gathering operational information that can be applied to the basic files to provide cost figures for a variety of units, routes, customers, etc.

DAILY INPUT TRANSACTION

FIELD SIZE	
6	MM DD YY - date of transaction activity
2	Route number
4	Vehicle number
5	Driver employee number
4	Total time charged to this route
4	Total time charged to loads
4	Tons of refuse picked up
3	Total Cubic yards dumped

Cost Reports

Understanding the various costs of commercial refuse collection and how they relate to the overall cost of the system is one of the most critical aspects of a successful operation. Unless a manager knows what his costs per ton, per route, per container, etc. are he is unable to plan strategies for improvement and savings.

With the wealth of information stored in each of the four files that make up the MIS, and with the daily activity sheets, cost information for a variety of levels is possible. This is done by multiplying the applicable prorated time charged to each customer on a route by the total route cost. The total route cost is computed by multiplying the total time necessary to service that route by the cost per unit of time for crew and vehicle. The resulting costs can be compared with "standard" costs for the route to determine performance. This information provides both top-level and supervisory management with common basis -- dollars and unit costs -- for analysis of operations.

The present MIS provides three cost reports, the cost per route (Weekly Route Summary), the cost per customer per route (Monthly Customer Cost Analysis by Route), and the cost per customer (Monthly Customer Cost Analysis). Each of these reports, as well as a sample print-out, is briefly described.

It should be emphasized again that the MIS presently being used to generate cost information is still in the developmental stage, and consequently is not as complete and refined as it will become. Nevertheless, the basic components and logic are sound, and can be adapted to most collection systems.

System Design

The cost analysis reports are run after each of the files are updated to reflect the most recent changes in customers, containers, equipment, and route. The various data are loaded on to tape and sorted into data sequence. The sorted tape is applied to data from the current Route and Equipment files to calculate a weekly cost for a route.

The next step in the cost analysis portion of the MIS is the calculation of cost by customer. To accomplish this the customer file is expanded to include one record for each route a customer is on. The expanded customer file is sorted into route number sequence and is used with the route equipment, and daily activity transactions for a designated period of time, also sorted into Route number sequence to calculate customer cost. The output of this program is a tape file in route sequence containing the following data elements:

Customer Account Number
Customer Address
Route Pick-up days (MTWTF)
Route and Sequence Number
Number Containers
Refuse Type Code
Maximum Volume of Refuse
Four Week Cost (calculated)
Four Week Billing Amount
Assigned Cubic Yards (calculated)
Assigned Tons (calculated)

From this tape is produced the customer cost analysis on two different levels. The first, is a report in route number sequence. The second of the customer cost reports, details costs by customer account number sequence.

A graphic presentation of this process is shown on exhibit VI-6.

Weekly Route Summary

The weekly route summary (exhibit VI-7) provides cost analysis for the total collection system by route. It gives the manager a "scope of operations" report by showing the following aggregates:

1) Total number of customers served.
2) Total number of containers served.
3) Total cubic yards collected.
4) Total tons collected.
5) Total downtime for all vehicles.
6) Total time for each route collected.
7) Total cost for all routes.
8) Performance evaluation.

The above information gives management a set of data that can be used for planning purposes. By correlating each of the above variables with one another over time the future demand can be anticipated, as well as what the costs of expansion might be.

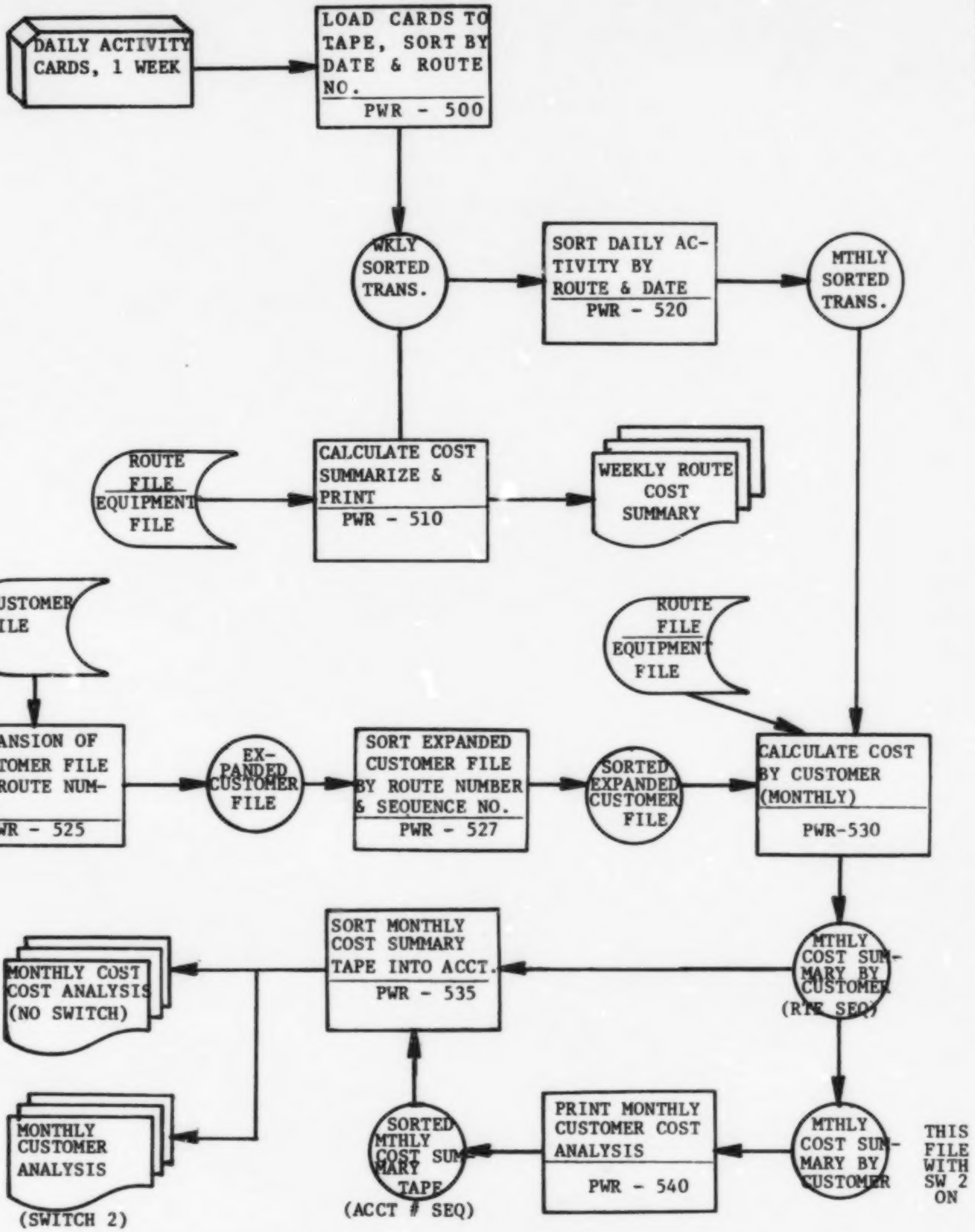

DAILY ACTIVITY CARDS, 1 WEEK
LOAD CARDS TO TAPE, SORT BY DATE & ROUTE NO.
PWR - 500
WKLY SORTED TRANS.
SORT DAILY ACTIVITY BY ROUTE & DATE
PWR - 520
MTHLY SORTED TRANS.
ROUTE FILE
EQUIPMENT FILE
CALCULATE COST SUMMARIZE & PRINT
PWR - 510
WEEKLY ROUTE COST SUMMARY
CUSTOMER FILE
ROUTE FILE
EQUIPMENT FILE
EXPANSION OF CUSTOMER FILE BY ROUTE NUMBER
PWR - 525
EXPANDED CUSTOMER FILE
SORT EXPANDED CUSTOMER FILE BY ROUTE NUMBER & SEQUENCE NO.
PWR - 527
SORTED EXPANDED CUSTOMER FILE
CALCULATE COST BY CUSTOMER (MONTHLY)
PWR-530
MTHLY COST SUMMARY BY CUSTOMER
(RTE SEQ)
SORT MONTHLY COST SUMMARY TAPE INTO ACCT.
PWR - 535
MONTHLY COST COST ANALYSIS (NO SWITCH)
MONTHLY CUSTOMER ANALYSIS
(SWITCH 2)
SORTED MTHLY COST SUMMARY TAPE
(ACCT # SEQ)
PRINT MONTHLY CUSTOMER COST ANALYSIS
PWR - 540
MTHLY COST SUMMARY BY CUSTOMER
THIS FILE WITH SW 2 ON

EXHIBIT VI-6. SYSTEM DESIGN FLOW CHART FOR COST REPORTS

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WEEKLY ROUTE SUMMARY 06/10/74

DATE	DAY OF WEEK	RTE #	DRIVER	VEH	CLIM	TRN STA	DOWN TIME	TOTAL TIME	# OF CUST	# OF CONT	TOTAL YARDS	AVG COST PER YARD	TOTAL TONS	AVG COST PER TON	TOTAL RTE COST	PERF
01 24 74	TH	99	THORL	0248	DRY	N	75	600	89	144	98	4.18	25	16.41	410.26	99%
01 28 74	MO	23	THORL	0248	DRY	N	0	690	80	139	103	4.58	26	18.16	472.34	71%
01 29 74	TU	20	LAWFD	0269	DRY	N	60	600	111	123	110	3.62	28	14.23	398.69	67%
02 01 74	FR	08	ROBLE	0264	DRY	N	0	555	35	151	90	4.56	23	17.87	411.16	89%
02 01 74	TH	99	THORL	0248	DRY	N	0	660	69	144	98	4.69	25	18.38	459.73	79%
02 04 74	MO	23	THORL	0248	DRY	N	0	690	86	139	98	4.79	25	18.81	470.34	71%
02 05 74	TU	20	LAWFD	0269	DRY	N	0	630	111	123	115	3.75	29	14.88	431.74	58%
02 08 74	FR	08	ROBLE	0264	DRY	N	0	600	35	151	90	4.80	23	18.80	432.53	83%
02 11 74	MO	23	THORL	0248	DRY	N	60	660	86	139	98	4.48	25	17.57	439.28	81%
02 12 74	TU	20	LAWFD	0269	DRY	N	60	450	111	123	85	3.67	21	14.87	312.40	82%
02 14 74	TH	99	THORL	0248	DRY	N	0	660	69	144	103	4.48	26	17.75	461.73	79%
02 15 74	FR	08	ROBLE	0264	DRY	N	0	470	35	151	90	4.63	23	18.14	417.27	87%
02 18 74	MO	23	THORL	0248	DRY	N	0	690	86	139	103	4.58	26	18.16	472.34	71%
02 19 74	TU	20	LAWFD	0269	DRY	N	0	510	111	123	90	4.00	23	15.68	360.71	62%
02 21 74	TH	99	THORL	0248	DRY	N	0	690	69	144	96	4.93	24	19.75	474.19	75%
02 22 74	FR	08	ROBLE	0264	DRY	N	0	550	35	151	90	4.53	23	17.74	408.11	90%
							255*		1284*	2228*	1557*		395*		6,832.82*	

AVERAGE COST PER CONTAINER	3.06**
AVERAGE COST PER TON	17.29**
AVERAGE COST PER YARD	4.38**

Exhibit VI-7. Weekly Route Summary Report

The weekly route summary also provides unit cost important to the manager in monitoring the cost of collection and comparing it with revenues generated or budgeted. The weekly route summary provides the following unit costs:

1) Average cost per container for all routes.
2) Average cost per ton for each route and all routes.
3) Average cost per cubic yard for each route and all routes.

This information is useful in establishing, changing, or analyzing user charges.

Additionally, the day and date of collection, along with meteorological conditions, are gathered for informational purposes to show possible correlation between these variables.

One of the most valuable analytical indices is the index of performance. This index compares actual route costs with "standard" route costs -- the cost of running a route given certain performance standards as detailed in the section on performance measurement.

Monthly Customer Cost Analysis By Route

The monthly customer cost analysis by route (exhibit VI-8) details the collection characteristics of each route and apportions the total cost of the route to each customer. The route is printed by sequence number (the chronological order in which the customers are serviced), and the following data are arrayed for each customer:

```
                                                                                                 PAGE   1
          PWR-540                               COMMERCIAL REFUSE
                                      MONTHLY CUSTOMER COST ANALYSIS BY ROUTE          DATE 06/10/74

RTE/SEQ   ACCOUNT NUMBER             SERVICE ADDRESS   P/U     CONTAINER   REF    ASSIGNED   ASSIGNED   4 WEEK
NUMBER                                                 MTWTF   NO.  VOL    TYPE    YARDS       TONS      COST
                                                                                     .00        .00      $.00

8/  1.0   90011463590002   00304   N HAYDEN RD          X       1    4     03        .54        .15     $12.37
8/  2.0   90001464000007   07664   E MCKELLIPS          X       1    6     01        .54        .15     $20.47
8/  3.0   90012448015001   07119   E CONTINENTAL        X       8   48     01       6.12       1.71    $100.87
8/  4.0   90012450059018   01101     SCOTTSDALE RD      X       1    6     05        .54        .14     $13.42
8/  5.0   90012453460001   07529   E MCDOWELL RD        X       4   24     02       2.43        .75     $71.43
8/  6.0   90015453080090   07440   E THOMAS             X      10   44     01       5.49       1.53    $106.19
8/  7.0   90014484265000   08379   E THOMAS RD          X       4   20     01       2.43        .68     $50.27
8/  8.0   90014479858009   08002   E OAK ST             X       3   14     01       1.80        .50     $29.02
8/  9.0   90014478957508   02330   N HAYDEN RD          X       1    4     02        .54        .16      $8.98
8/ 10.0   90014470199002   02501   N HAYDEN RD          X       1    4     04        .54        .16      $7.67
8/ 11.0   90014470260093   02529   N HAYDEN RD          X       2    8     02        .54        .16     $23.93
8/ 12.0   90013465015004   07934   E OAK ST             X       1    2     02        .00        .00     $10.77
8/ 13.0   90013465858005   02240   N HAYDEN RD          X       1    3     02        .00        .00      $9.73
8/ 14.0   90013467750006   07902   E MCDOWELL RD        X       7   27     02       2.43        .75     $59.34
```

Exhibit VI-8. Monthly Customer Cost Analysis by Route

1) Number and volume of containers

2) Refuse type

3) Assigned yards

4) Assigned tons

5) Monthly cost of servicing this customer on this route

The route report also identifies the total yards, tons, and costs for the route.

Monthly Customer Cost Analysis

The monthly customer cost report (Exhibit VI-9) is arrayed by account number. Thus, customers on multiple routes appear together on the report as separate entries, allowing for a reasonableness check on the data collected. In addition, the variance between the billed amount and the cost will show how equitable the user charge system is in assigning costs.

PWR-540

COMMERCIAL REFUSE

MONTHLY CUSTOMER COST ANALYSIS

PAGE 5

DATE 06/10/74

ACCOUNT NUMBER		SERVICE ADDRESS	P/U MTWTF	RTE/SEQ NUMBER	CONTAINER NO.	CONTAINER VOL	REF TYPE	ASSIGNED YARDS	ASSIGNED TONS	4 WEEK BILL AMT	4 WEEK COST	VARIANCE
90023450020008	07849	N SCOTTSDALE RD	X	99/ 5.0	1	6	02	1.39	.42	4.00	$40.12	$40.12
			X	23/ 3.0								
90023450021008	27303	N SCOTTSDALE RD	X	23/ 3.0	2	2	02	2.88	.89	$.00	$65.50	$65.50
			X	23/ 81.0								
90023470005005	07008	N HAYDEN	X	23/ 81.0	11	3	01	10.55	2.94	$.00	$309.56	$309.56
			X	99/ 80.0								
90023475000000	08241	E INDIAN BEND	X	99/ 80.0	1	4	02	1.39	.42	$.00	$23.54	$23.54
			X	23/ 33.0								
90023486000001	07330	N PIMA RD	X	23/ 33.0	1	6	02	1.39	.42	$.00	$33.80	$33.80
			X	23/ 79.0								
90028441000002	16905	E GOLDDUST	X	23/ 79.0	5	28	02	5.97	1.86	$.00	$148.97	$148.97
			X	99/ 76.0								
90028445000002	10350	N SCOTTSDALE RD	X	99/ 76.0	1	2	02	.00	.00	$.00	$21.65	$21.65

Exhibit VI-9. Monthly Customer Cost Analysis

APPENDIX VII

USER CHARGE SYSTEM

APPENDIX VII

USER CHARGE SYSTEM

Introduction

One of the objectives of the cost accounting and management information system development was installation and evaluation of a user charge system which would be equitable to all customers. During the term of this project, the MIS was not sufficiently refined to allow the detail in the different files to be used as the data base for user charge determination. However, the basic components of the user charge system were derived from work elements that have been and will be utilized in the MIS.

In theory a user charge system attempts to assign to each customer the true portion of the cost of collection. Although the statement of the theory is straight forward, the number of ways charges are computed and applied vary widely. The following procedure was used by Scottsdale to revise its rate structure based on costs and use. Similar procedures may be used by other cities or private refuse collectors, as the methodology is relatively simple.

Time Computations

To develop a user charge system a thorough study of commercial refuse routes, under varied conditions, was made. It was determined that one unit to which all operations could be related was time. It was then decided that time could be expressed as a dollar value through a fairly straight forward conversion process.

For the purposes of this study, it was decided to divide time on a refuse collection route into three basic categories:

(1) Haul Time: This is composed of three components of time not directly involved with collection. The first is time to the route at the beginning and from the landfill at the end of the day. The second is the time to, at, and from the sanitary landfill. The third is the "non-productive time" such as lunch, coffee breaks, etc. assigned to the route.

(2) Service Time: This is the total time required to service the customer on his property. It includes four different components, maneuvering into position, lifting and dumping the container(s), compacting the load, and leaving the property (egress).

(3) Travel Time: This is the time required on the public roadway between customers on the route. Travel time for customer B, for example, would be one-half the time between customers A & B plus one-half the time between customers B & C.

These categories of time, when added together, represent the total time spent on a route. In order to allocate time it was then determined that these categories related to three corresponding characteristics of the customer in the following manner:

(1) Haul Time is related to the volume of refuse picked up from a customer. As the volume increases, so also does the necessity for transport to the landfill. We assumed a direct relationship for our rate schedule,

and prorated each customer's share of the haul time based on the total volume of service required by the customer. We chose not to consider effects of varying compaction ratios, since most of our customers are either commercial or residential and there is relatively little variation among customers. A more refined rate schedule would consider this factor.

(2) Service Time is related to the number of containers to be picked up at the customer's site. By prorating loading time to each customer based on the number of containers the increased cost of servicing additional containers, rather than additional capacity, is reflected. Again, we prorated service costs to containers serviced without regard to variations in access time among customers. A more refined rate schedule might charge customers for their share of service time based on field measurements or the formulas discussed in Appendix VI, Performance Measurement for Commercial Refuse Collection.

(3) Travel Time is related to the number of customers on the route. For the purposes of our rate schedule we prorated all travel time equally to each customer, and based that rate on the number of collections they receive. Other methods of prorating travel time were considered. We decided against charging each customer his share of actual travel time since he had no control

over his location on the routes.

At this point, the relative importance of each category was determined by following, timing, and recording the movements of refuse collection vehicles on nineteen different ways and routes (a sample data collection sheet is shown in Figure VII -1). These data were then analyzed to determine the "standard" or average times for each of the three categories, and their relation to the total time on the route. Although there were differences between the actual times recorded from customer to customer, the data showed that, in general, the standard times were reasonable approximations of the actual time required for each customer. The standard times were determined to be:

Haul time = .25 minutes per cubic yard of service required by the customer per pick up.

Service time = 2.00 minutes per container per pick up required by the customer.

Travel time = 1.21 minutes per customer per pick up.

Relating Time to Cost

The next step was conversion of the standard times to dollar values to compute user charges. This was done in the following manner:

(1) Total annual costs were computed for the entire commercial refuse collection system. The costs included both business and residential customers with bins that are serviced by commercial collection. (Residential customers comprise approximately 50% of all commercial collection customers). In the case of

ROUTE NUMBER ____________
TRUCK NUMBER ____________
TOTAL DAILY MILEAGE ________

DAY & DATE ________
DRIVER NUMBER ______
TIME LEFT YARD ______

TIME RETURNED TO YD. ______
COMMENTS ____________
____

ACCOUNT NUMBER	CUSTOMER NAME	TRAVEL TIME	SERVICE TIME	NO. OF CONTAINERS	VOL. OF CONTAINERS

FIGURE VII-1 - ROUTE DETAIL WORK SHEET

a municipal system this may be done by either looking at the 12 month actual costs or by using the annual budget. It is important that all costs be computed, including administrative overhead, billing, container repair, and refuse disposal. All operating equipment should be depreciated out over its useful life. Private collections will add taxes and a profit margin to these costs. A sample cost calculation is presented in Figure VII-2.

(2) The total annual operating hours are computed. This figure will reflect the number of hours of equipment operation necessary to secure all routes for the entire year. A simple way to calculate this figure is to multiply the number of routes (assuming one route per shift) by the number of hours worked per week per driver and then multiplying that total by 52 (the number of weeks in the year).

(3) The total cost is divided by the total operating hours. This figure gives a cost per hour for commercial refuse collection. This figure is divided by 60 to derive the cost per minute of refuse collection. This figure can then be used as a dollar expression of time (a base cost) and can be multiplied by the standard times of collection categories to obtain unit costs for each customer.

PERSONNEL	NO. OF PERSONNEL	SALARY RANGE	BUDGET
Refuse Collection Supvr.	.25	929-1,186	3,375
Refuse Collection Foreman	1.00	863-1,102	13,152
Container Repair Leadman	1.00	708- 904	10,435
Equipment Operator III	9.00	782- 998	101,372
Equipment Operator I	1.00	611- 780	7,431
Clerk-Steno II	1.00	553- 706	8,562
Container Repairman	2.00	674- 861	16,614
City Workman	3.00	527- 672	19,263
Overtime			12,500
		Total Salaries & Wages	192,704
		Social Security	10,541
		State Retirement	8,360
		Industrial Insurance	8,822
		Life, Health, Other	9,209
		Sub-total Benefits	36,932
		TOTAL PERSONNEL COSTS	$229,636

1. TOTAL PERSONNEL COSTS $229,636

2. EQUIPMENT

Operation (includes fuel, maintenance, repair, etc.) $207,520

10 Packers @ $10/hrs. 1,920 hrs/yr = 192,000
5 Pickups @ $60/M x 12 months = 3,600
1 Boom Truck @ $6/hr x 1,920 hr/yr = 11,520
1 Fork Lift @ $2.50/hr x 1,920 hr/yr = 400

Depreciation (capitalization of purchase cost over useful life) 79,380

10 Packers @ $600/month x 12 months = 72,000
5 Pickups @ $60/month x 12 months = 3,600
1 Boom Truck @ $240/month x 12 mos = 2,880
1 Fork Lift @ $75/month x 12 mos = 900

3. LANDFILL COSTS @ .75/cubic yard 69,200

4. COMMODITIES & OTHER EXPENSES 34,221

$619,957

FIGURE VII-2 -- p. 1
SAMPLE COST CALCULATION

Direct Costs Commercial Refuse System	$619,957
Public Works Department Overhead 11% X $79,800 (11% is estimated time & resources spent on commercial refuse)	8,778
Utility Billing Costs	8,025
Part-time Salaries	21,315
	$658,075*

$658,075/yr ÷ 16,000 operating hrs/yr - $41.13/Op. Hr.
or $0.6855 per operating minute

* The total cost ($658,000) does not include the cost of physical facilities -- the yard, administrative office space, storage and parking areas for containers and equipment, etc. This cost for private collection may run as high as 15% of total operating cost.

This cost does not include any profit or tax provision. The most appropriate place to compute or add in profit would be at the end of all cost computations. Thus, if 10% profit is the target, the total cost plus profit would be $658,075 + $65,808, or $723,883.

Taxes would have to be added in at the appropriate level. For example, taxes on equipment would be added to equipment costs.

FIGURE VII - 2 — p. 2
SAMPLE COST CALCULATION

Computing the Rate Schedule

Once the base cost is established the many possible combinations of collection service to customers can be computed. The rate schedule is shown in Figure VII-3; an example of the conversion formula is shown in Figure VII-4.

The rate schedule also specifies charges for other services provided by the city at cost, including charges for special hauls, caster installation, and container roll-out. Provision is also made for containers shared by two or more customers.

Conclusions

The user charge system is based on the assumption that the cost of commercial refuse collection of service should be borne by and distributed equitably among the customers choosing to make use of that service. The major difference between the former system and the present system is that larger users of the collection service and the city's general fund no longer subsidize the costs of refuse collection service to smaller customers formerly receiving free service. This difference becomes even more apparent when the former user charge system (Figure VII-5) is compared with the new user charge system (Figure VII-6, Ordinance 794). The difference can also be seen by comparing these two systems with the charges of comparable collection systems, both public and private (Figure VII-7).

There are many refinements of the user charge system that can be made, and Scottsdale is continuing to accumulate data on the

No. of Weekly Pickups	CONTAINER SIZE (CUBIC YARDS)					
	2	3	4	5	6	8
			ONE CONTAINER			
1	$11.00	$12.00	$12.50	$13.50	$14.00	$15.50
2	22.00	24.00	25.00	27.00	28.00	31.00
3	33.00	36.00	37.50	40.50	42.00	46.50
4	44.00	48.00	50.00	54.00	56.00	61.00
5	55.00	60.00	62.50	67.50	70.00	77.00
			TWO CONTAINERS			
1	18.50	20.00	21.50	23.00	24.50	27.50
2	37.00	40.00	43.00	46.00	49.00	55.00
3	55.50	60.00	64.50	69.00	73.50	82.50
4	74.00	80.00	86.00	92.00	98.00	110.00
5	92.50	100.00	107.50	115.00	122.50	137.50
			THREE CONTAINERS			
1	26.00	28.00	30.50	32.50	35.00	39.50
2	52.00	56.00	61.00	65.00	70.00	79.00
3	78.00	84.00	91.50	97.50	105.00	118.50
4	104.00	112.00	122.00	130.00	140.00	158.00
5	130.00	140.00	152.50	162.50	175.00	197.50
			FOUR CONTAINERS			
1	33.50	36.50	39.50	42.50	45.00	51.00
2	67.00	73.00	79.00	85.00	90.00	102.00
3	100.50	109.50	118.50	127.50	135.00	153.00
4	134.00	146.00	158.00	170.00	180.00	204.00
5	167.50	182.50	197.50	212.50	225.00	255.00

ADDITIONAL FEES:

$15.00 for delivery of each container after initial service.
$50.00 for each set of casters installed on container by City crews.
$2.00 for each container each time it must be rolled out by the driver prior to collection.
$ .70 for each yard of precompacted material collected,

SPECIAL HAULS:

Unusual or unique situations may be covered individually by special rates determined by the Refuse Superintendent and based on the cost of the service provided.

NOTE: Containers must be purchased by the customer and are maintained by the City's Refuse Division.

SHARED CONTAINERS:

When two or more customers share a container, the following options are available for payment:

1. The service charges will be billed to the customer requesting the initial service at the regular rate indicated in the rate structure. It will then be the responsibility of the businesses sharing the container to share the cost among themselves.
2. If Option 1 is not selected, each business will be charged $7.50 or two-thirds of the cost of the container capacity required based on the rate schedule, whichever is greater.

FIGURE VII-3.
COMMERCIAL REFUSE MONTHLY RATE CHARGES

SAMPLE RATE STRUCTURE CALCULATION

Suppose a customer has two - 4-yard containers that are picked up twice a week. The monthly charge of providing service, and therefore the user charge, would be computed as follows:

Haul Time = 8 x .25 x $0.686 x 2 x 4.33 = $11.88

Where

8 = cubic yds. of service provided to customer
.25 = minutes per cubic yard
.686 = dollars per minute cost
2 = number of pickups per week
4.33 = number of weeks in a month

Service Time = 2 x 2 x 2 x 4.33 x $0.686 = 23.76

Where

2 = minutes per container
2 = number of containers
2 = number of pickups per week
4.33 = number of weeks in a month

.686 = dollars per minute cost

Travel Time = 1.21 x 4.33 x 2 x $0.686 = 7.19

Where

1.21 = minutes per customer
4.33 = number of weeks in a month
2 = number of pickups per week
.686 = dollars per minute cost

$42.83

FIGURE VII - 4

actual cost per customer in conjunction of the equipment modeling and performance data in these appendices. For example, the assigning of average times to each and every customer is somewhat arbitrary. We expect to utilize the MIS to more equitably charge each customer directly for his actual share of the cost of servicing his establishment.

Postcript

When the ordinance installing user charges was brought before the City Council, it was their guidance that all rates be reduced by $3.00 to give businessmen parity with residential customers who receive collection service without charge. Thus Ordinance 794 (Figure VII-6) reflects this rate reduction.

The revenue expected to be generated through this rate structure is calculated in Figure VII-8. It should be pointed out that the amount expected ($327,373) represents an attempt to recover only those costs associated with business establishments. Residential units such as apartments, townhouses, and condominiums that utilize collection bins are serviced by the commercial collection system free of charge, by direction of the City Council.

SCHEDULE OF MONTHLY REFUSE SERVICE RATES

RESIDENTIAL

Residences & Apartments: No charge for regular twice per week pick up at the right of way. Minimum of $1.00 per dwelling unit per month charge for service by collection trains off the right of way.

Mobile Home Parks: $1.00 per mobile home for regular twice per per week pick up or normal commercial rates for containers.

Carry-out Service: $3.00 plus 2¢ per foot for each man load normally carried.

COMMERCIAL

Containers will be provided and maintained by the City and normally serviced twice each week.

$5.00 for each yard capacity more than 3 up to 6;

$2.00 for each yard capacity more than 6;

$5.00 for each container more than 1;

$15.00 for delivery of each container after initial service;

2.00 for each yard capacity for each day's service more than two per week.

$3.00 per set for casters on containers. Unusual or unique situations may be covered individually by rates based on the cost of service computed by the Sanitation Superintendent.

SPECIAL HAULS: $4.00 plus $1.00 per yard capacity for each service to a container.

$4.00 plus $4.00 per yard for loose material or

$4.00 per ton or $10.00 per hour for a truck and two men, whichever is more.

FIGURE VII - 5. OLD USER CHARGE SYSTEM.

ORDINANCE NO. 794

AN ORDINANCE OF THE COUNCIL OF THE CITY OF
SCOTTSDALE, MARICOPA COUNTY, ARIZONA, AMENDING
SECTION 9-414 OF THE SCOTTSDALE REVISED CODE
RELATING TO COLLECTION RATES FOR COMMERCIAL
REFUSE AND DECLARING AN EMERGENCY.

FIGURE VII-6 -- p. 1

RATE STRUCTURE REVIEW

BE IT ORDAINED by the Council of the City of Scottsdale, Arizona, as follows:

SECTION 1. Section 9-414 of Chapter 4, Article 1 of the Scottsdale Revised Code is amended to read:

9-414. Monthly charges for commercial refuse collection.

A. The following monthly charges for commercial refuse collection are established as set forth below:

	CONTAINER SIZE (CUBIC YARDS)					
No. of Weekly Pickups	2	3	4	5	6	8
			ONE CONTAINER			
1	$ 8.00	$ 9.00	$ 9.50	$10.50	$11.00	$12.50
2	19.00	21.00	22.00	24.00	25.00	28.00
3	30.00	33.00	34.50	37.50	39.00	43.50
4	41.00	45.00	47.00	51.00	53.00	58.00
5	52.00	57.00	59.50	64.50	67.00	74.00
			TWO CONTAINERS			
1	15.50	17.00	18.50	20.00	21.50	24.50
2	34.00	37.00	40.00	43.00	46.00	52.00
3	52.50	57.00	61.50	66.00	70.50	79.50
4	71.00	77.00	83.00	89.00	95.00	107.00
5	89.50	97.00	104.50	112.00	119.50	134.50
			THREE CONTAINERS			
1	23.00	25.00	27.50	29.50	32.00	36.50
2	49.00	53.00	58.00	62.00	67.00	76.00
3	75.00	81.00	88.50	94.50	102.00	115.50
4	101.00	109.00	119.00	127.00	137.00	155.00
5	127.00	137.00	149.50	159.50	172.00	194.50
			FOUR CONTAINERS			
1	30.50	33.50	36.50	39.50	42.00	48.00
2	64.00	70.00	76.00	82.00	87.00	99.00
3	97.50	106.50	115.50	124.50	132.00	150.00
4	131.00	143.00	155.00	167.00	177.00	201.00
5	164.50	179.50	194.50	209.50	222.00	252.00

B. If any customer has more than four (4) containers the monthly rate for commercial refuse collection shall be determined by the Superintendent of the Refuse Division based upon the schedule in sub-section A of this section. The following additional fees shall also be charged as follows:

$15.00 for delivery of each container after initial service.

$50.00 for each set of casters installed on container by City crews.

$ 2.00 for each container each time it must be rolled out by the driver prior to collection.

C. Notwithstanding any other provision to the contrary, the Superintendent of the Refuse Division is empowered to establish special rates for unusual or unique situations and such rates shall be based upon the cost of the service provided.

D. When two or more customers share a container in common, one of the following charges may be elected:

1. The service charges will be billed to the customer requesting the initial service at the regular rate indicated in the rate structure. It shall be the responsibility of the businesses sharing the container to share the cost among themselves.
2. If Option 1 is not selected, each business will be charged $7.50 or two-thirds of the cost of the container capacity required based on the rate schedule, whichever is greater. These businesses which generate no more than 100 gallons per week of domestic or non-putrescible waste (as determined by the Refuse Division Superintendent) shall be charged at the rate of $4.00 per month.

SECTION 2. WHEREAS, the immediate operation of the provisions of this ordinance is necessary for the preservation of the public peace, health, safety and welfare, an EMERGENCY is hereby declared to exist and this ordinance shall be in full force and effect from and after its final passage and adoption by the City Council.

PASSED AND ADOPTED by the Council of the City of Scottsdale, this 7th day of MAY, 1974.

B. L. TIMS, O.D., MAYOR

ATTEST:

Fern Anderson Bell, City Clerk

FIGURE VII-6 -- p. 2

RATE STRUCTURE REVIEW

COMMERCIAL REFUSE FEE COMPARISONS

MONTHLY RATE (DOLLARS)

SIZE OF CONTAINER	NO. P.U.'S PER WEEK	CITY OF SCOTTSDALE PRESENT	CITY OF SCOTTSDALE PROPOSED*	CITY OF MESA	WASTE CONTROL OF ARIZ. (UNIVERSAL REFUSE)
3 cu. yd.	2	0	21	30	33
	3	6	33	42	45
	4	12	45	54	57
4 cu. yd.	2	5	22	32	41
	3	13	34.50	45	55
	4	21	47	59	69
6 cu. yd.	2	15	25	36	50
	3	27	39	50	68
	4	39	53	65	86
	5	51	67	77	104
8 cu. yd.	2	19	28	38	62
	3	35	43.50	53	84
	4	51	58	68	106
	5	67	73.50	83	128

* These rates reflect the $3.00 reduction as directed by the City Council. (See Postcript).

FIGURE VII -7. COMPARISON OF NEW USER CHARGES WITH OLD CHARGES, CITY OF MESA CHARGES, AND UNIVERSAL REFUSE CHARGES.

2 Collections Per Week	Container Size	No. of Cont's.	X	Monthly Charge	Expected Monthly Revenue	
	2	22	X	$19.00	$ 418	
	3	194	X	21.00	4,074	
	4	309	X	22.00	6,798	
	5	34	X	24.00	816	
	6	139	X	25.00	3.475	
	8	38	X	28.00	1,064	
		736				
					SUBTOTAL	$16,645
3 Collections Per Week	4	11	X	34.50	380	
	5	2	X	37.50	75	
	6	33	X	39.00	1,287	
		46				
					SUBTOTAL	$ 1,742
4 Collections Per Week	4	7	X	47.00	329	
	5	5	X	51.00	255	
	6	34	X	53.00	1,802	
	8	1	X	58.00	58	
		47				
					SUBTOTAL	$ 2,444
5 Collections Per Week	4	19	X	59.50	1,131	
	6	60	X	67.00	4,020	
		79				
					SUBTOTAL	$ 5,151
TOTAL CONTAINERS		908				
TOTAL EXPECTED MONTHLY REVENUE =						$25,982

TOTAL ANNUAL REVENUE EXPECTED = $311,784
(at present level of service offered)

Based on recent estimates of commercial business growth in Scottsdale, we expect to be asked to provide an additional 5% of refuse services to businesses, with an additional expected revenue of ---------------------- $15,589

TOTAL REVENUE EXPECTED (FY 74-75) $327,373

FIGURE VII-8. CALCULATION OF ANNUAL PROJECTED REVENUE USING ADOPTED RATE STRUCTURE.

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